PMM

OCTOBER

1956

Precision Metal Molding

INCLUDING DIE CASTINGS MAGAZINE

devoted exclusively to:

DIE CASTINGS

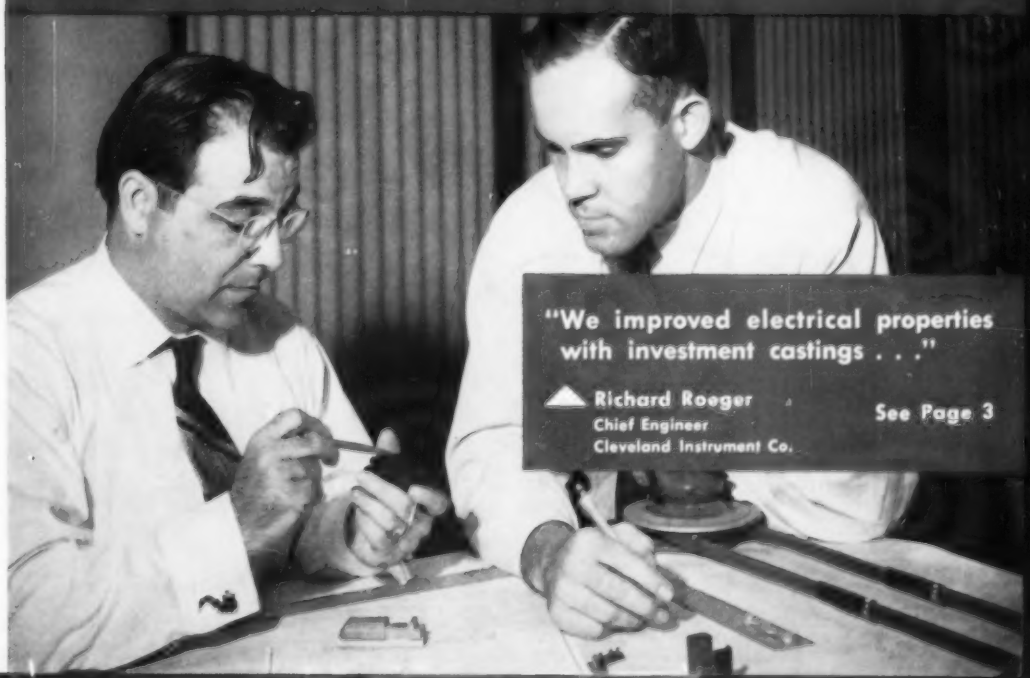
INVESTMENT CASTINGS

ERMANENT MOLD CASTINGS

PLASTER MOLD CASTINGS

POWDER METALLURGY

SHELL MOLD CASTINGS



"We improved electrical properties with investment castings . . ."

Richard Roeger
Chief Engineer
Cleveland Instrument Co.

See Page 3

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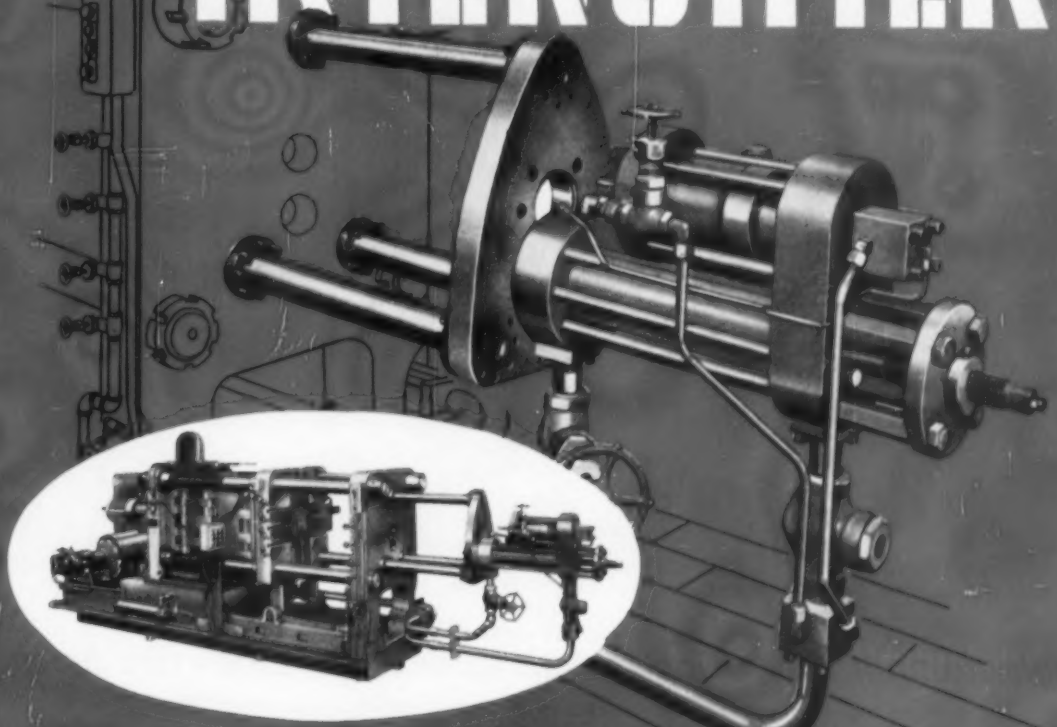

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COVER STORY

ELECTRONIC gaging instruments made by Cleveland Instrument make increased use of investment castings. Chief Engineer Richard Roeger, right, and Plant Manager Robert Chetlan are shown here examining the newest castings. Story starts on pg. 60.

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OCTOBER, 1956 VOLUME 14 NUMBER 10

Precision Metal Molding

FEATURE ARTICLES

39 **GEARS IN LIGHT METALS** solve many design problems.

40 **WEAR BEHAVIOR OF HIGH TEMPERATURE BEARING MATERIALS:** powder metallurgy helps find a new aircraft material.

42 **DO POWDERED METAL PARTS MEET DESIGN NEEDS OF BUSINESS MACHINES?** Leading manufacturers use these parts.

46 **ALUMINUM CASTINGS FOR RAIN WATER AND FIRE WATER.**

49 **EVEN A LOW-COST PRODUCT CAN BE PRECISION-BUILT:** a student microscope is built of die castings.

51 **THERE'S A PMM CASTING ALLOY FOR YOUR PRODUCT:** tabulation of the typical alloys being cast by five precision processes.

60 **YOU CAN IMPROVE ELECTRICAL PROPERTIES WITH CAST STRUCTURE:** an instrument builder turns to investment castings.

105 **HOW TO CONTROL TEMPERATURE IN DIE CASTING DIES**—Part 4.

FINISHING SECTION

67 **BELT GRINDING CAN REPLACE MACHINING OF FLAT SURFACES**

70 **VACUUM PLATING . . . $30 PER LOAD:** a case history of a manufacturer of auto radios.

REGULAR DEPARTMENTS

9 Casting About
12 Recent Patents
16 Data in Ads
27 Between the Lines
30 News about People
35 Letters to the Editor
81 Useful Literature
92 New Products
103 Opportunities

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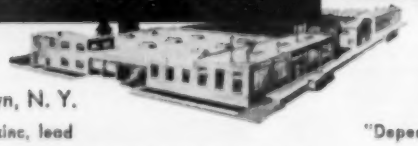

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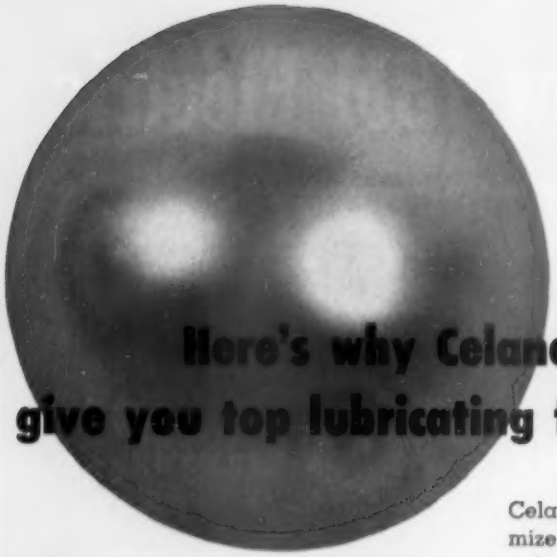
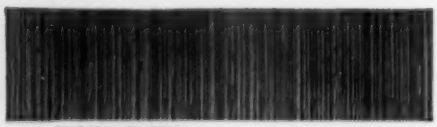


Here's why Celanese fire-resistant CELLULUBES give you top lubricating features

UNUSED PATH



PHOSPHATE ESTER

PETROLEUM OIL

PHOSPHATE ESTER BASE

WATER-GLYCOL BASE

Photomicrographs of the surface of ball path of bearing operated in four hydraulic fluids: petroleum oil, phosphate ester, phosphate ester base, and water-glycol base. Fluids were evaluated on a transfer test machine where angular contact bearings were operated to point of failure. Of the combustion resistant fluids tested, the straight phosphate ester gave the longest bearing modal life and the related ball path showed the least number of microscopic pits.[1]

Celanese Cellulubes are phosphate ester fluids designed to minimize the hazard of flash fires and explosions inherent in many industrial operations.

CONTAIN NO ADDITIVES

Because they contain no additives, Cellulubes give you excellent lubricating qualities, in addition to built-in fire-resistance. Just check these basic advantages offered by Cellulubes:

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- STABILITY —**unaffected by heat, wear or oxidants**
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[1] From a report in *Lubrication Engineering*, July-Aug., 1956, entitled "A Study of Combustion Resistant Hydraulic Fluids as Ball Bearing Lubricants," by H. V. Cordiano, E. P. Cochran, Jr., and R. J. Wolfe.

Reprints of this article are available from Celanese Chemical Division on request.

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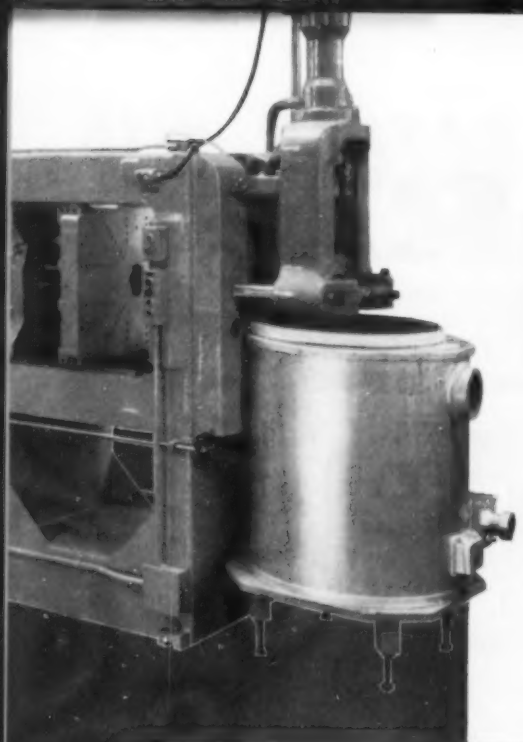

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for ZINC

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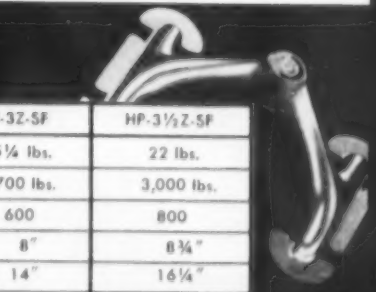
Equivalent Bar Size	2″	5″	6½″	8″	8¾″
Die Opens	9″	10″	12″	14″	16¼″
Clearance Between Beams (HxV)	14″ x 12″	17″ x 22¼″	18½″ x 26″	26″ x 28¼″	30″ x 36″

*Established with strain-gage equipment simulating a die...under supervision of independent consulting engineer.



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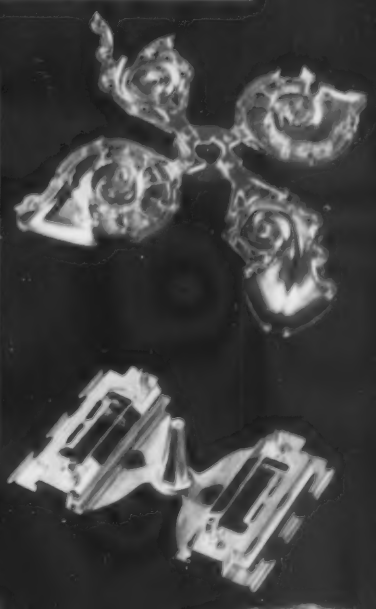

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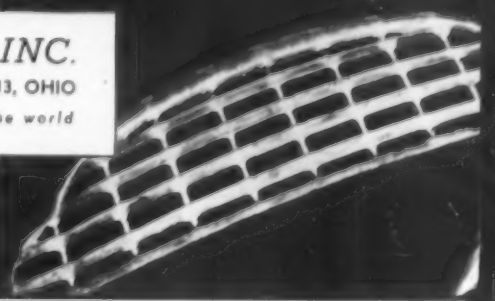

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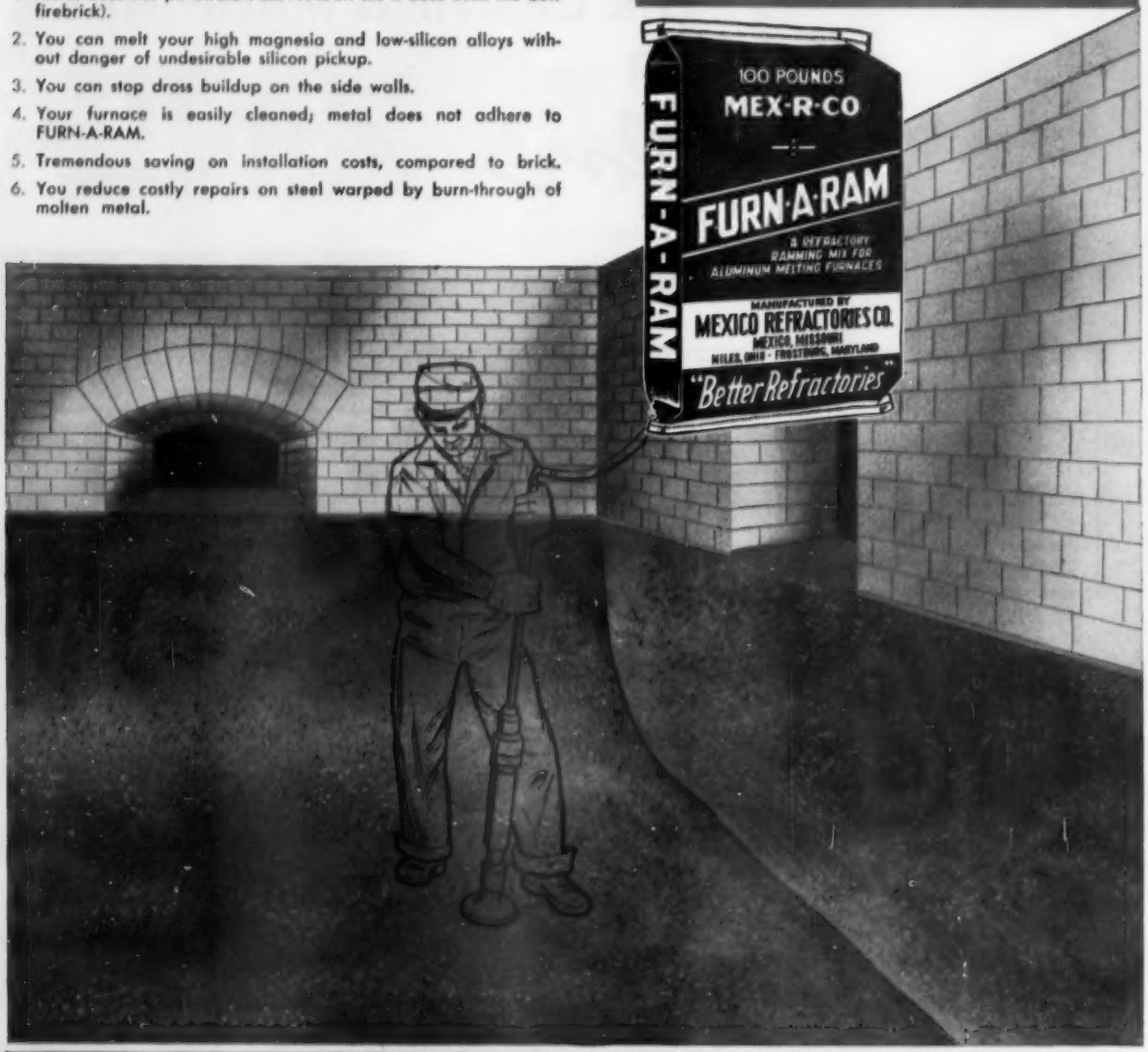

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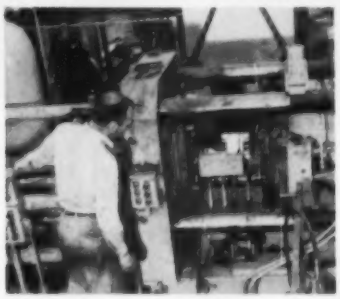
CASTING ABOUT

technical news of applications & processes involving precision metal moldings

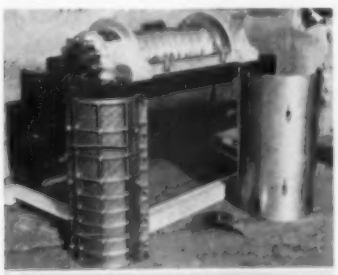
EXPENDABLE AND EXPANDABLE PATTERNS are the key to a new process of investment casting reported in the current copy of Armour Research Foundation's Newsletter. A patent is now pending on a technique that leaves the expanded polystyrene pattern in the mold to be burned out by the hot, molten metal. Castings so far are reported to be rough, but it might have application in experimental work.

"MOST MODERN ELECTRIC MOTOR PLANT" is the claim General Electric Company makes for its new highly-mechanized production lines set up in Schenectady at a cost of about $7 million. For the first time, a company spokesman explains, electric induction motors in the 7½ to 30 hp range are being produced on a mass production basis. One feature is the pressure die casting of rotors. Internal fan fins are cast as one piece with the rotor for extra strength. Shown here is a view of the rotor casting operation.



A $200,000 DEVELOPMENT CONTRACT has been awarded to Horizons Inc., by the Navy Bureau of Aeronautics, covering development of a commercial method for producing virgin titanium metal by an improved Horizon's electrolytic process. The new process, according to Dr. Eugene Wainer, vice president and director of research, has been in an experimental stage for two years. Horizons' lab work indicates the new process will be the most economical yet discovered. This is a modification of the original fused salt electrolysis process.

CITRUS FRUIT JUICE is processed by this screw finisher which handles pulps with high liquid-to-solid ratio. This highly sanitary machine is manufactured by Canning Machinery Division of the Food Machinery and Chemical Corp., Hoopeston, Ill. It has a capacity of 50 to 60 gallons per minute. Main functional component of this machine is the extra long cast stainless screw conveyor. The double spiral screw is a hollow casting of type CF-16F (comparable to wrought 303) with approximately ¼" walls, except for the ends, which are one inch thick. It is machined to final dimensions: 14" diam., 42½" length. In operation, the pulp flows from the hopper into the large screw of the finisher. The screw rotates at 225 rpm, pushing the pulp forward to an ever-decreasing volume, thus straining the pure juice through the screen that surrounds the screw. The last foot of the screw has practically no taper to allow time for the last drops of juice to drain.



Continued on page 11

Dodge Custom-made
Special Alloy Steel Goosenecks

. . . for longer service life
. . . less maintenance

Here's the biggest news in die casting in years: a custom-made special alloy *steel* gooseneck that will outlast and outperform iron and alloy iron goosenecks currently available . . . and provide greater operational savings! Developed through years of experience and association with the die castings industry, Dodge Special Alloy *Steel* Goosenecks provide many advantages:

- Will outlast iron and alloy iron goosenecks by as much as 4-5 years.
- Maintenance problems are fewer because of long service life.
- Down time is reduced to a minimum because of long service life.
- Designed and made of special alloy *steel*, they prevent cracking . . . bottom breakout . . . spout erosion.

Each Dodge Special Alloy *Steel* Gooseneck is custom made to specifications by the Finished Products Division of Dodge Steel Company. Facilities are available for producing any size gooseneck for any die casting machine. Goosenecks are furnished either rough machined or machined with sleeves. Dodge provides a complete engineering service in the designing and production of steel goosenecks.

Your inquiries are solicited, without obligation, of course. Ask too, about pots and other die casting machine parts including nozzles, spouts, plungers, etc.

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AMCO® METAL POWDERS

critical parts at less cost

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For example, AMCO Metal Powders were among those chosen for fabricating precision parts for the IBM *407 Electric Accounting Machine*. Specifying AMCO Metal Powders is a good start toward ensuring that these parts will be uniform, have sharper, cleaner details and dimensional stability, and meet tolerances as exacting as 0.0005 inch—with a minimum of finishing or machining.

If your metal-powder parts must adhere to rigid specifications, or if you require a blend that guarantees special product characteristics, further information on AMCO Metal Powders will interest you. Please contact the Metal Sales Department—

Precision lobe cams and aligner arms compacted from AMCO metal powders meet ±0.0005-inch accuracy required for the IBM 407—without machining! The electrolytic copper powder used in this application has a *minimum purity of 99.8 percent.*

THE AMERICAN METAL COMPANY, LTD.

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CASTING ABOUT

continued from page 9

HOW TO SELL gray iron castings will be studied by a newly organized committee of the Gray Iron Founders' Society. The marketing committee has endorsed a broad marketing program designed to help members improve their marketing practices and enlarge the over-all market for gray iron castings. According to Donald H. Workman, executive V.P. of the GIFS, marketing in the industry has not kept pace with other technological advancements.

MORE PRIMARY ALUMINUM will be produced by a new $231 million company formed jointly by Olin Mathieson Chemical Corp. and Revere Copper and Brass, Inc. The new venture should produce 180,000 tons a year. Olin Mathieson has contracted with Olin Revere Metals Corp., as the new firm is called, for 120,000 tons of primary aluminum per year . . . twice the amount the corporation was to produce under its original program for entering the primary aluminum industry. Revere has made a similar contract with the new company for 60,000 tons a year. Facilities will include an alumina plant near the Gulf Coast, a reduction plant now under construction near Clarington, Ohio, and a new power subsidiary wholly owned by Olin Revere with three 225,000 KW generating plants.

POWER BRAKES are taking hold, according to a report from American Motors, whose vice president Roy Abernethy has announced that power brakes on Rambler, Nash and Hudson cars increased from 11.6 percent in 1955 to 61.6 percent in 1956. Other power equipment also gained: automatic transmissions up from 55.5 to 60.9 percent, All-Season air conditioning from 6.6 to 6.7 percent, and power steering from 3.2 to 7.5 percent.

HOUSTON MAY BECOME the chief source of high strength alloy steel in the Central region of the United States following an expansion project announced by officials of Sheffield Steel, a division of Armco Steel Corp. Designed to "meet the steel needs of the Southwest's expanding economy," Sheffield has now authorized construction of a large heat treating plant for tempering, normalizing and annealing special alloy steel. Late last year the company announced plant enlargements which will increase ingot capacity of the Houston plant from 1 million to 1¼ million tons a year.

Westinghouse pilot plant for precision castings speeds development, saves capital investment

Incubator for casting ideas

To help you prove your precision casting ideas and developments under production conditions, Westinghouse invites you to use its new pilot plant facilities at Blairsville, Pa. Thus you can speed your metals programs without heavy capital investment.

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PMM PATENTS

Copies of all patents reviewed can be secured from U. S. Patent Office, Dept. of Commerce, Washington, D. C. for 25¢ each.

A REINFORCING FOR SHELL MOLDS in which the mold, after forming and baking is coated on the back side with a mixture that is from 0.9 to 13% water, 0.07 to 7.0% sodium silicate and the balance dry sand (percentages are by weight) and then baking the reinforced mold for at least two minutes at a temperature between 300F and 700F.

Process For Reinforcing Shell Molds—William S. Hacket—assigned to General Motors Corp.—patent no. 256,309—issued June 5, 1956.

A METHOD FOR PRODUCING FERROUS metal powders. A purified solution of a salt of the metal is held in a confined space and subjected, alternately, to vacuum and an inert gas to remove dissolved oxygen. The oxygen-free solution under the inert atmosphere is then treated with an alkali metal amalgam to form a ferrous metal amalgam. This latter material is mechanically concentrated while still under an inert atmosphere and the mercury distilled off at a temperature below the sintering temperature of the metal.

Method of Producing Metal Powders—Morris Eisenberg—patent no. 2,749,234—issued June 5, 1956.

A METHOD FOR PRODUCING TITANIUM as a coarse crystalline powder by the electrolysis of fused titanium tetrachloride on a cathode of inert material. The fused salt bath is made up of alkali metal halides, alkaline earth metal halides and mixtures of them. The cell is so arranged that a continuous stream of titanium tetrachloride is added adjacent to the cathode with the electrolyzing current set so that continuous reduction of the titanium salt occurs without building up the titanium concentration in the fused salt bath any where except immediately next to the cathode. The titanium is deposited as a tenaciously adhering coarse crystalline deposit.

Electrolytic Production of Titanium—Kjell A. Svanstrom and William R. Opie—assigned to National Lead Co.—patent no. 2,749,295—issued June 5, 1956.

A PROCESS FOR PREPARING AN IRON COPPER POWDER suitable for use in powder metallurgical processes in which a mixture of iron, in the form of iron powder or iron oxide, and copper, in the form of metallic copper, copper oxide or copper chloride, are placed in a reduction furnace containing a reducing atmosphere essentially hydrogen with or without the addition of hydrogen chloride gas. Reduction is carried out at an elevated temperature until the iron and/or the copper is reduced to metal.

Patents No. 2,754,193; 2,794,194; 2,794,195—Process for Making Copper-Iron Powder—Marion Ernest Graham and William A. Reed—assigned to Republic Steel Corp.—issued July 10, 1956.

A METHOD OF MAKING A SINTERED carbide having substantially the same coefficient of expansion as steel. Separately formed Cr_3C_2 and Cr_7C are mixed with a binder of either nickel or cobalt. The mixture contains from 40% to 60%, by weight, of Cr_3C_2 and 25% to 45% of Cr_7C, the total carbide content to be between 86% and 90% of the batch and the ratio of the Cr_3C_2 to Cr_7C to be between 1:1 and 7:3. The binder material to be between 10% and 12%. The mixture is then pressed and sintered.

Patent No. 2,753,621—Sintered Carbide Compositions and Method of Making the Same—William W. Wellborn—assigned to Firth Sterling, Inc.—issued July 10, 1956.

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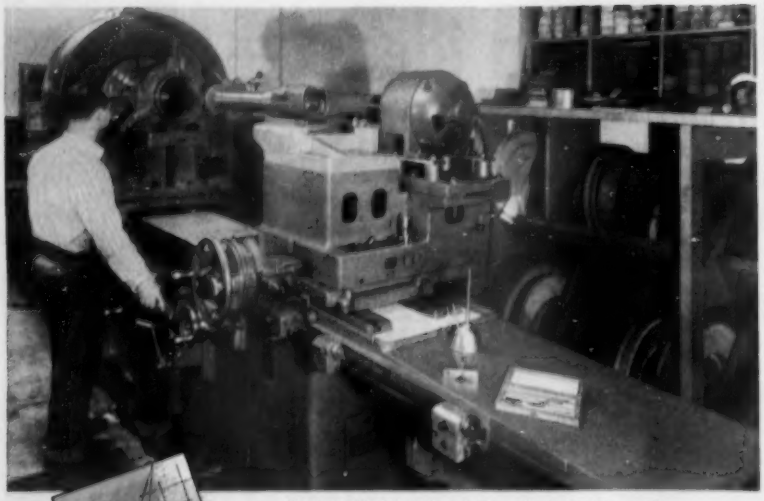

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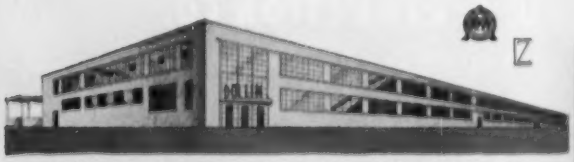

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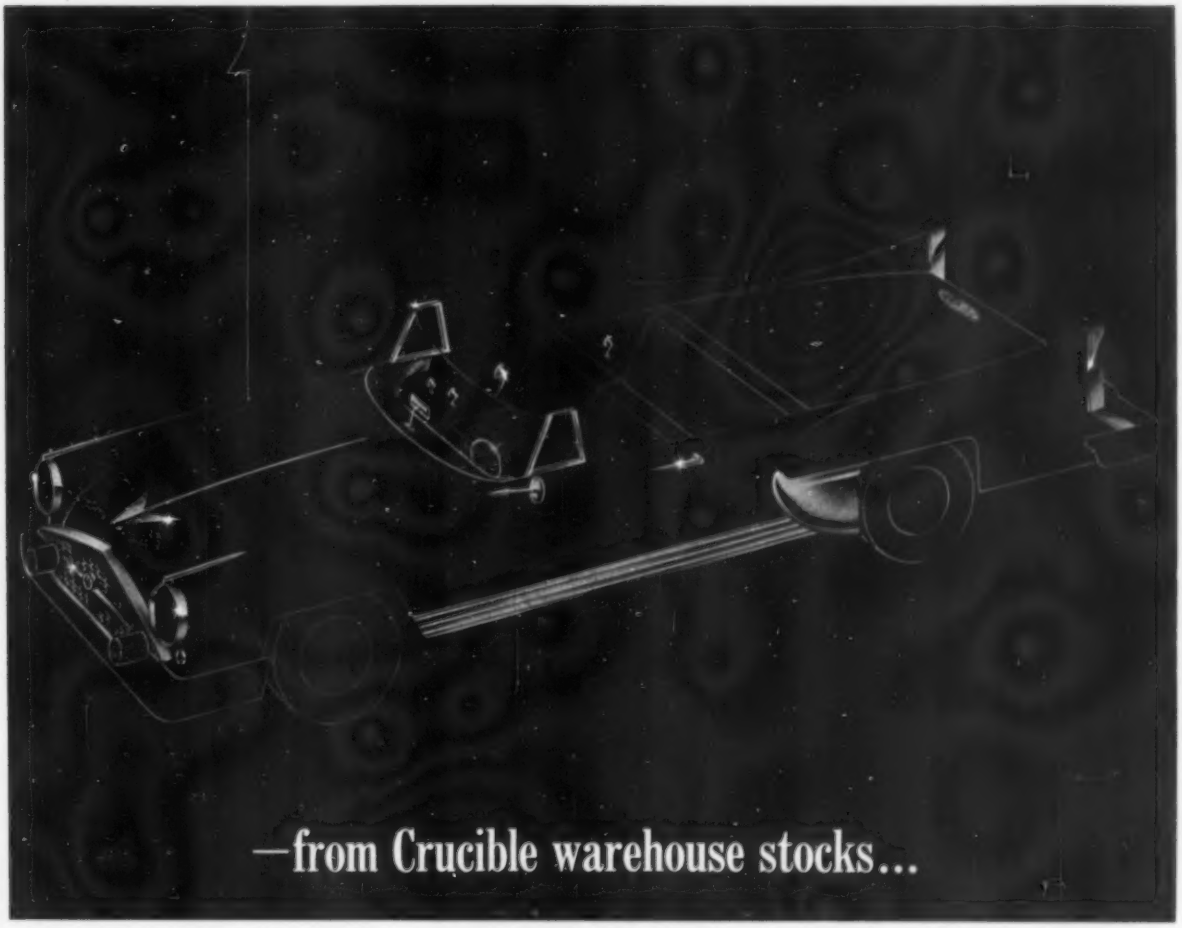

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DATA OFFERED IN THIS MONTH'S ADS

the Reader Service Cards on the facing page will get you these free reference materials. Circle the numbers and mail.

1. **1000 Shots Per Hour**—according to bulletin A-10, an engineering report on small die casting machines, from ABC Die Casting Machine Co.
2. **Die Casting Supplies**—An illustrated bulletin from ACF Industries, Inc. describes their complete line of pots, castings, ingot molds, and goosenecks for the die casting industry.
4. **Colloidal Dispersions for Casting**—Bulletin 425 from Acheson Colloids Co. describes the different lubricants available for foundry use.
6. **Low Cost, High Speed**—die casting machines are described and all of the specifications given in an illustrated folder from the American Die Casting Machinery Co.
8. **Heat Exchangers for Die Casting Machines**—Bulletin 1.1K5 from the Ross Heat Exchanger Div., of American Standard gives the details of these units as applied to die casting machines.
10. **Aluminum Alloy**—designed specifically for die casting is fully described and the as-cast properties given in specification sheets on alloy Z-39 from Apex Smelting Co.
11. **Powder Metal Presses**—in four available sizes are described in technical data from Dorst Div. of Arnhold Ceramics, Inc.
12. **Alloy Metal Powders**—The use of these powders in the fabrication of parts and the properties of the parts made from them are covered in detailed reports from Alloy Metal Powders, Inc.
13. **Die Casting Machine Specifications**—Complete specifications on the different models of die casting machines now being built are given in literature from B & T Machinery Co.
16. **Metal Melting Facilities**—A new booklet describes the air and vacuum melting facilities available at Cannon-Muskegon Corp. and also the alloys and metal forms that can be supplied.
19. **Fire-Resistant Fluids**—Technical data are available from Celanese Corp. of America, Chemical Div., on Cellulubes, fire-resistant fluids for hydraulic systems.
20. **Wax Injection Equipment**—In Bulletin 1202, the Centrifugal Casting Supply Co. describes and gives complete operational data on their injection equipment for industrial waxes.
22. **Powder Metal Parts**—Engineering data and application information on Oilite powder metal bearings, parts, and filters is given in the new manual E-56 from Amplex Div., Chrysler Corp.
23. **Improved Die Casting**—production is said to be possible in literature on the Model 400-N die casting machine built by Cleveland Automatic Machine Co.
24. **Crucible Melting Handbook**—A revised edition of this handbook on crucible melting furnaces for "cold chamber" die casting is now available from Crucible Manufacturers' Association.
29. **Sprue Bushings & Spreaders**—Complete specification sheets giving all of the uses and advantages of specially designed sprue bushings and sprue spreaders are available from Detroit Mold Engineering Co.
35. **Lubricants for Aluminum**—Bulletins describing the most suitable lubricant for the various methods of working aluminum are available from Fiske Bros. Refining Co.
36. **Refractory Mold Materials**—Literature has been released on mold materials that feature a uniform coefficient of thermal expansion up to 2400 F, higher fusion point, and other advantages, by Harbison-Walker Refractories Co.
37. **Engineering Data**—as well as technical information and recommended uses are included in a new booklet on zinc base die casting alloys prepared by Henning Bros. & Smith, Inc.
38. **Investment Casting Aid**—Design, application, and manufacturing data have been published by Hitchiner Mfg. Co. to show engineers the most economical and best use of investment castings.
39. **Die Castings**—A booklet has been issued by the Hoover Co. that describes the company's production and research facilities available to customers.
40. **Die Casting Machines**—In bulletin 5400-J, the Hydraulic Press Mfg. Co. describes the different die casting machines made by the company. Complete data on all machines are included.
41. **Induction Melting**—The advantages of induction melting and other important items of melting practice are discussed in detailed literature from the Inductotherm Corp.
44. **Tilting Arc Melting**—furnaces with a capacity of 15 lbs. of steel and requiring only 12 KW are explained in a bulletin on the type PT Detroit Electric Furnace issued by Kuhlman Electric Co.
46. **Die Casting Machines**—Complete information on their line of zinc die casting machines is offered in bulletin 101 from Lester-Phoenix, Inc.
47. **Automatic Ladling Unit**—Information has been published by Lindberg Engineering Co. on "Little Joe," an automatic ladling unit for aluminum casting.
48. **Designing Die Castings**—A booklet on design of parts to be die cast has been prepared by Litemetal Dicast, Inc.
51. **Refractory Ramming Mix**—Literature published by Mexico Refractories Co. describes Furn-A-Ram, a refractory ramming mix for aluminum melting furnaces.
55. **Standard Bearings**—National Molded Products, Inc. has issued a listing of standard size bushings and bearings carried in stock. Sizes, load data, etc. are given.
56. **Iron Powder Data**—A new data sheet has been issued on the properties and uses of B-261 Plast-Iron powder by National-U. S. Radiator Corp., Plastic Metals Div.
58. **Zinc Die Castings**—More than 80 examples of production and sales advantages of conversion to zinc die castings are presented in a booklet from The New Jersey Zinc Co.
59. **Dies By Hobbing**—are said to reduce tooling costs. How, when, and why to hob is told in a booklet from Newark Die Hobbing & Casting Co.

Continued on page 22

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8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305
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7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296
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11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305
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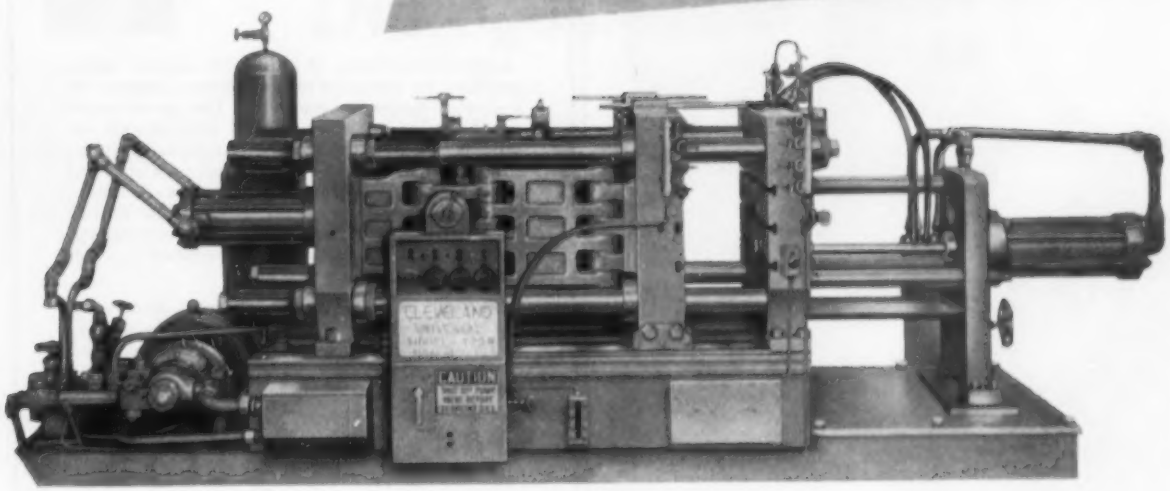
Cleveland Model 400-N
shown with cold chamber end.



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Here are the features of the Cleveland Model 400-N that will give you better castings, faster, at less cost:

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- Powerful die locking pressure — 400 tons, strain gauge tested.
- Rapid, smooth die closing and opening for high production operation.
- High metal injection speeds to produce sound, dense, hardware finish castings.
- Safe, simple control—manual or automatic.
- Ample room for die mounting, for operation and maintenance.
- Universal construction — easily convertible for either hot or cold chamber operation.

To get the most from your die casting department —in speed of production and quality of castings —investigate the many advantages of the Model 400-N Cleveland. Let the Cleveland sales engineer in your area show you how the Model 400-N can improve your die casting production with money saved . . . or write direct for full details.

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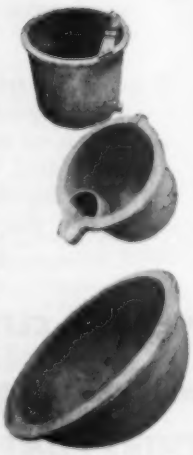

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HOW A DOUBLE CONVERTER HOUSING WAS CAST IN ONE PIECE

By F. S. Ross, Vice-President in charge of Engineering Centr-O-Cast and Engineering Co.

The manufacturer of industrial engines had a problem: he needed a cast aluminum housing for a double hydraulic converter. The piece would weigh 70 lbs., and was highly complicated, involving cast-in hydraulic lines, a cast-in hydraulic sump, and numerous apertures, all of which had to be held to close finishing tolerances. Actually, the housing called for three castings, but to justify the design of the part, cost-wise, it seemed essential that it be cast all in one piece . . . and that was the problem.

Different casting methods were tried. Sand casting was attempted first, because it is usually economical. In this case, however, it was not, and the castings were poor. Permanent mold would give the required accuracy, but the intricate internal areas of the part presented a problem. The process that *did* work involved both of the two other techniques: semi-permanent mold. The exterior and the sump section of the part were formed in a permanent mold, while the top and half of the inside were formed in dry sand.

The permanent portion of the mold for this casting is a unique assembly. Rather than being a single mold, it consists of five separate outside shoes forming the exterior of the part, and these shoes move back and forth on five individual axes, making the total assembly similar to the petals on a flower. All are hydraulically operated, allowing us to cycle the mold properly.

We used a heavy riser for the casting, through a heavy dry sand core, with three separate pouring sprues on the flanges of the sump. By using a cover core, we were able to feed the heavy hydraulic oil-tight passages and still preserve the good dimensional accuracy of the permanent mold casting. The lower parts of the casting were very thick but quite sound, and the apertures and flanges were highly accurate. On all faces, only a minimum of stock remained to be machined. Because the casting when in use must withstand terrific strain, we had been concerned with getting sufficient wall thickness, but the finished piece proved that the original design for a 3/16" wall was more than adequate.

By casting this housing in semi-permanent mold, we succeeded in retaining the advantages of both permanent mold and sand casting. The finishing tolerances were very close, the structure was sound throughout, and the cost figure was excellent.

centr-O-cast

AND ENGINEERING COMPANY

45 St. Jean Avenue • Detroit, Michigan

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AN IMPORTANT MESSAGE TO BUYERS AND SELLERS OF DIE CASTINGS

To be published in the January, 1957, issue of PMM

Where To Buy Die Castings

For the first time: The Die Castings Directory, an authoritative source-book and buyers' guide for users of die castings

WHY Since 1943, PMM has been industry's information center on die castings and die castings sources. PMM works hard to provide readers with authoritative answers to their requests for sources of various types of die castings. The Die Castings Directory will contribute to that effort. It will fill an important void in readers' reference files: it will give them *up-to-date facts* about *all* U. S. sources for custom die castings.

VALUE TO READERS The Die Castings Directory will present, for the first time anywhere, all sources for custom die castings in this country, *authenticated* and *organized for easy reference* by castings buyers and engineers.

INCLUDING Every jobbing die caster in the U. S. who supplies basic Directory information to PMM will be included in the Die Castings Directory. Forms for listings are available from the editor, PMM, Room 800, 812 Huron Rd., Cleveland.

VALUE TO ADVERTISERS This will be the buyers' guide of die castings. It will offer an ideal opportunity to present yourself to buyers *right when they are looking* for die castings sources. And, because the Die Castings Directory will become part of the buyers' permanent source-book files, your advertising will have unusually long life.

LISTINGS The Die Castings Directory will have three sections. *Geographical:* giving company names and addresses within each state and city. *Alphabetical:* including every company with its address, plus facts about metals cast, additional services offered, trade names and trade marks. *Trade Marks:* giving names and addresses of owners plus actual reproductions of all die casting firms' trade marks.

IN ADDITION All advertisers' listings will be printed in bold face type and will include (in Section 2) a complete listing — with full addresses — of all sales and field engineering representatives.

TIMING Publication date: January 3, 1957. Deadline for Directory listings: November 12, 1956. Advertising deadline: December 3, 1956. For complete details and samples of the Directory format, contact

812 HURON RD.
CLEVELAND 15, OHIO

Die Slick case histories

"Your Die Slick No. 9 has enabled us to produce zinc castings with a cleaner and better surface finish."
Northern Iowa Die Caster

"With Die Slick our dies operate almost twice as long without cleaning due to practically no carbon formation on cores and ejector pins."
Large Chicago Manufacturer

"We are now casting a .405" wall casting which would not be possible without Die Slick. Thanks for a marvelous product."
Midwest Diecasting Jobber

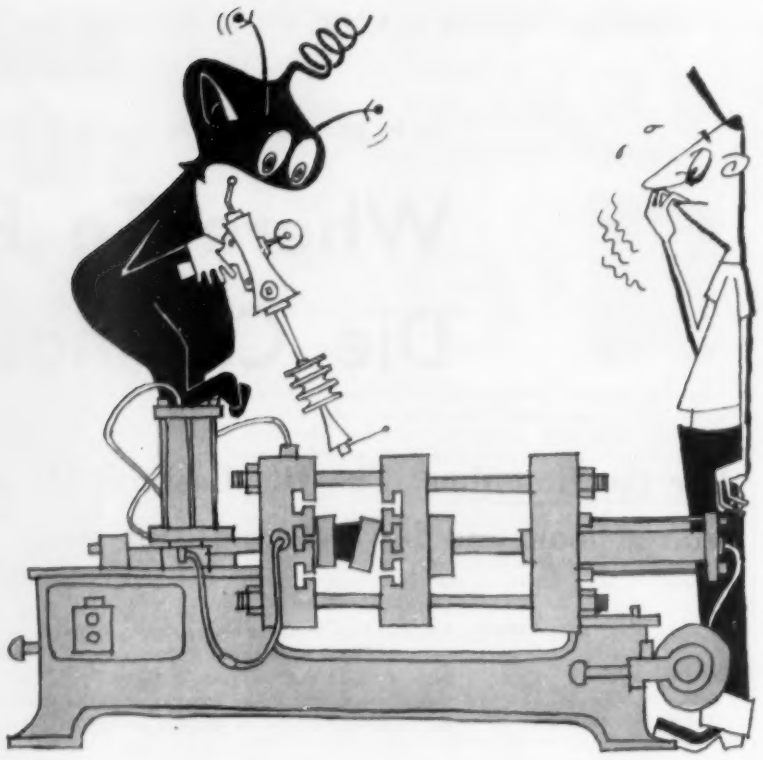
"Die Slick has increased our production rate and improved the quality of our castings."
Michigan Manufacturer

"Your Plunger-Slick is the greatest plunger lubricant we have ever used . . . and we have tried them all."
Western Diecaster

"I have been with the pressure die casting business since its experimental stages and have tried everything imaginable to prevent galling and still get good surface finish . . . and can truthfully say Die Slick No. 3 is the very best."
Well-known Southern Diecaster

"On hardware jobs it (Die Slick #9) has shown a marked improvement on the finish of the castings."
Large Chicago Diecaster

"We are using Die Slick by the 55-Gal. drum because it keeps our scrap down to a minimum and our die cavities free from scale."
Large New Jersey Producer of Automotive Hardware



Don't Disintegrate . . . use Die Slick!

Use Die Slick to prevent sticking, scoring, ejector pin wear on any metal or alloy you are die casting. For instance, there are several grades of Die Slick for aluminum which meet every requirement, no matter how high the heat, how intricate the die, or how fast the rate of production. To find the correct grade for your operation, simply write, outlining what metal or alloy you are using, pounds of metal per shot, a description of the part, and special considerations. Order a week's supply of Die Slick and try it at our risk. If you are unsatisfied for any reason, return the invoice unpaid. Put Die Slick to work for you now!

Die Slick is a registered trade mark of G. W. Smith & Sons, Inc.

DIE SLICK

used by die casters everywhere

G. W. SMITH & SONS, INC., 5400 KEMP ROAD, DAYTON 3, OHIO

For more information circle No. 70 on the Reader Service Card

Earmarks of Quality

with MADISON-KIPP zinc and aluminum die castings

A MOST VITAL FACTOR in designing is to get the "quality look" at no cost increase or even at a saving.

In the Two Circuit Double Break Push Button Micro Hand Switch here illustrated, the first and lasting impression is high quality. The functional holes, bosses, ribs, unyielding strength, and inherent stability are plus factors.

Please clip this ad as a reminder to contact us when you have die casting requirements.

kipp

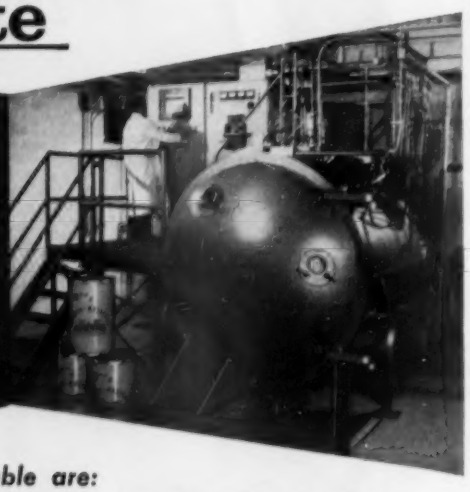
MADISON-KIPP CORPORATION
218 WAUBESA STREET • MADISON 10, WIS., U. S. A.

- Skilled in Die Casting Mechanics
- Experienced in Lubrication Engineering
- Originators of Really High Speed Air Tools

For more information circle No. 49 on the Reader Service Card

Now...Cannon-Muskegon offers complete

VACUUM MELTING service and UltraMet alloys...



Now available are:

stainless, tool and die, magnetic steels — high-temperature, corrosion-resistant, expansion alloys — bearing steels — electrical and electronic alloys — special alloys

RIGHT NOW . . . Cannon-Muskegon provides you with a ready source of super-clean, superior strength alloys to meet complex metallurgical applications. Our completely equipped and expertly staffed vacuum melting facilities as well as chemical, physical and metallurgical laboratory can help you *find, test and produce* vacuum melted alloys for any application . . . in test or production quantities . . . with accurately predictable properties.

Ferrous, nickel and cobalt-base alloys are poured at pressures from 1 to 10 microns — resulting in extremely clean metals for smoother surfaces . . . greater tensile strength, ductility and wear life . . . and higher electrical and magnetic properties. Contact Cannon-Muskegon for facts.

We offer industry

- ***Materials for remelt*** — under conventional air melting, inert gas, vacuum.
- ***Casting development*** — includes research and experimental facilities for investment, shell mold, dry sand, and permanent mold castings.
- ***Ingots or cast billets*** — for rolling, forging or extruding in individual weights up to 250 pounds.

Finest laboratory and production equipment is used in our vacuum-melting operation . . . available to you. Let our metallurgical specialists help you solve your alloy problem.

For full particulars write for our New Bulletin on Vacuum-Melting and Air-Melting facilities, products and service.

ULTRA MET
VACUUM-MELTED ALLOYS
FOR INDUSTRY

CANNON-MUSKEGON CORPORATION

2871 Lincoln Street — Muskegon, Michigan

METALLURGICAL SPECIALISTS

For more information circle No. 18 on the Reader Service Card

DATA IN ADS

continued from page 16

60. **Cost Cutting By Die Casting**—A descriptive brochure has been issued by Paramount Die Casting Co. describing the facilities that are available to help cut costs through the use of die castings.

63. **Stainless Steel Plunger Rings**—A special bulletin has been released by Precision Piston Rings, Inc. on the properties and advantages of their stainless steel plunger rings.

64. **Hydrogen Reduced Iron Powders**—produced by Pyron Corp. are covered in technical data now being offered.

65. **Vacuum Die Casting**—Full information on the advantages of the Vacucast Process for zinc die castings is available from Reed-Prentice Corp.

66. **Powdered Metal Parts**—in a range of metals are illustrated in a folder from Reese Metal Products Corp., showing their facilities for powder metallurgy.

67. **Iron Powder Advantages**—Iron powder specifically tailored to give high strength with controlled dimensional changes is discussed in literature from the Republic Steel Corp.

69. **Oil Base, Fire-Resistant Fluid**—Test data and information have been released by Shell Oil Co. on Irus Fluid 902, an oil base, fire-resistant hydraulic fluid used as a direct replacement for hydraulic oils now in service.

71. **Stainless Steel Ladles**—and skimmers for non-ferrous metals are listed in data from Spincraft, Inc. Sizes in stock and prices are also included.

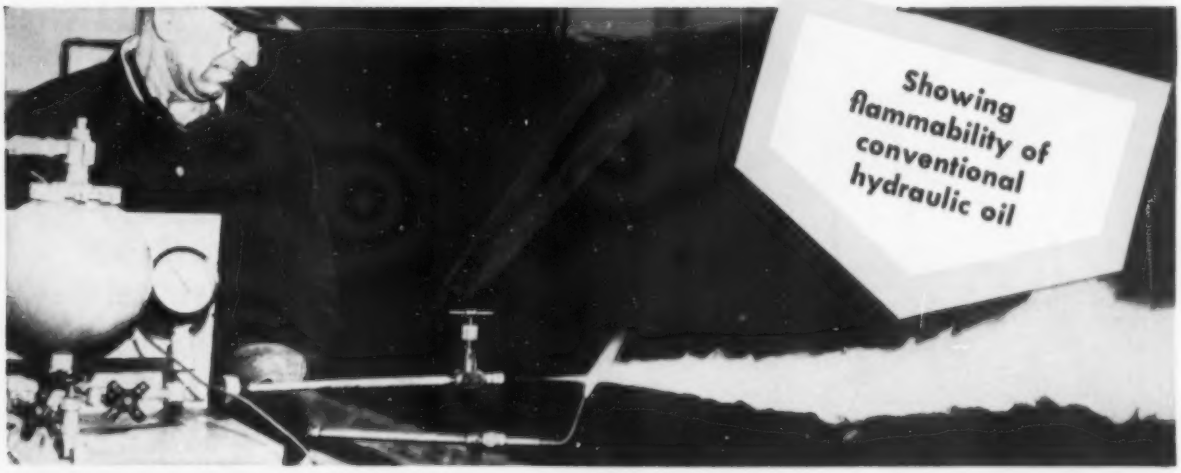
76. **Pilot Plant Casting**—In bulletin DB-52-500, Westinghouse Electric Corp. discusses the facilities for pilot plant casting production and prototype manufacture in the new metals plant.

77. **Barrel Finishing**—by the Abbott method is described in literature from The Abbott Ball Co.

78. **Non-Ferrous Finishing**—Detailed laboratory and engineering reports on the finishing of non-ferrous metals by the Iridite process are available from Allied Research Products, Inc.

79. **Barrel Finishing**—A new catalog from Almco Div., Queen Stove Works, Inc. shows how the Supersheen barrel finishing process can be adapted to many types of metal parts.

Continued on page 91



Flame tests prove its fire-snuffing ability

SHELL
IRUS
FLUID 902

Entirely new formula: Shell Irus Fluid 902 is a special formulation . . . product of three years' development and field testing. It is suitable for nearly all industrial hydraulic systems, as a direct replacement for presently used oils. *Here is a fire-resistant hydraulic fluid that can be widely used.*

Non-corrosive: Shell Irus Fluid 902 contains no corrosive ingredients. It has no harmful effects on seals, fittings or bearings. It does not promote rust.

No major modification necessary . . . simply clean present fluid thoroughly out of system and replace directly with Shell Irus Fluid 902. You can use it with complete confidence. Write for test data and all information.

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

For more information circle No. 69 on the Reader Service Card

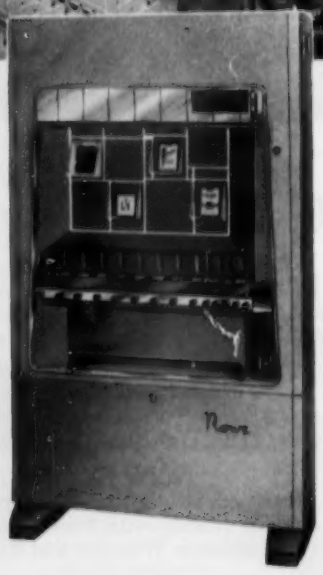
SHELL

PRODUCTION SHORT CUTS WITH

ZINC DIE CASTINGS

NUMBER 3 OF A SERIES

MAKING THE SALE FOR .... Rowe®



When you make a purchase from the familiar Rowe Ambassador cigarette machine, the coins are handled almost completely by a series of intricately shaped ZINC Die Castings. A die cast plunger then delivers the package you select. The efficiency with which this mechanical business transaction takes place is the result of expert engineering which has made Rowe "America's First Automatic Merchandising Family."

These are the outstanding production advantages provided by the use of ZINC Die Castings for the vital cigarette machine components:

1. Avoidance of expensive machining—the castings are virtually ready for assembly as received from the die caster.
2. Minimizing of assembly operations—unusual complexity of shape makes one part serve in place of several if produced by other means.
3. Assurance of trouble-free operation through sturdy construction and close dimensional control of all castings in long production runs.
4. Ability to take and hold economical and attractive plated coatings (external castings only, internal parts are used "as is").

The continuous use of ZINC Die Castings by Rowe Manufacturing Company, Inc. through many machine design improvements, over a long period of years, is a tribute to the fine performance of such parts under rough everyday operation. For possible answers to *your* production problems through the use of ZINC Die Castings, send for our brochure and contact any commercial die casting company.

Send for your copy

ZINC
FOR DIE CASTING ALLOYS

The New Jersey Zinc Company, 160 Front Street, New York 38, N. Y.

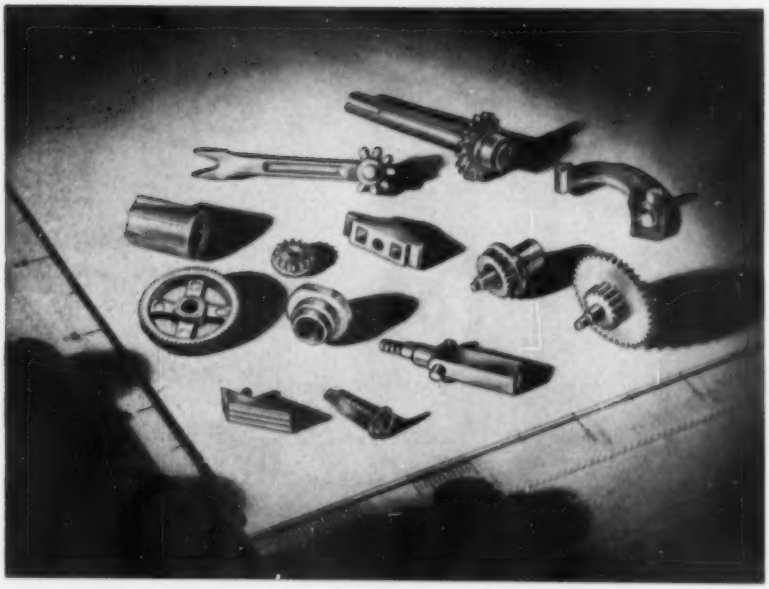
The Research was done, the Alloys were developed, and most Die Castings are based on

HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC

For more information circle No. 58 on the Reader Service Card

NEW GRC TINY DIE CAST PARTS EMPHASIZE BIG OPPORTUNITIES FOR IMPROVED DESIGN

NOW! Design change problems minimized because Gries' techniques are flexible, adaptable.



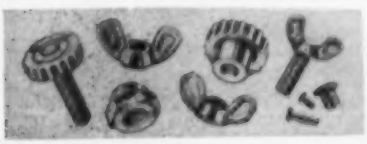
Design engineers find their work simplified by utilizing the unique die casting techniques developed by Gries Reproducer Corporation.

Gries manufactures simple or intricate zinc alloy parts in one high-speed, economical process. Problems such as additional manufacturing operations to produce slots, square holes, flats on round surfaces, etc. can usually be eliminated. GRC zinc alloy die cast parts are turned out completely trimmed, ready for use, in one automatic operation by Gries *exclusive* methods.

All this adds up to exceptional economy in the production of small parts, whether making changes in existing designs or planning new ones.

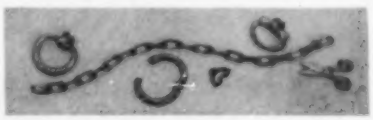
Gries' small parts are made to precise specifications. Maximum length 1¾ inches, maximum weight ½ ounce; smallness unlimited. All are mass-produced at low cost in quantities of 100,000 to many millions.

Send for Gries' fact-filled bulletin on tiny die castings today.



Gries Makes Extensive Line of Die Cast Zinc Alloy Threaded Fasteners

Gries produces by their exclusive die casting technique a line of high quality, low cost threaded fasteners, including wing nuts, cap nuts, wing screws, round-head thumb nuts, round-head thumb screws, rivets, which are available in a wide range of sizes. Quick delivery from stock. Specials to order. All are non-ferrous, rustproof, with clean threads and bright finish. GRC mass production techniques provide lower costs. A new bulletin is now available. Write for your copy of Gries Industrial Fastener Bulletin.



GRC "Intercast" Die Casting Offers Multiple-Parts Units with Movable Parts

In one automatic operation, Gries can "intercast" die cast tiny parts with movable elements, completely assembled, trimmed and ready to use. Elements fit precisely, yet move freely. Production of individual multiple-unit products or continuous "intercast" units is fast, economical and unique.

The "sister-hook" picture frame swivel rings, scissors, loose-leaf binder rings are 2-element movable "intercast" parts, whereas the chain shown in the photo is an example of continuous "intercasting". Send for samples and full information.

Exclusive Production Facilities Offered by Gries

At the modern Gries plant in Westchester County, New York, production facilities are geared to turn out quantities of 100,000 to many millions, completely trimmed and degated, ready for use. Smallness is unlimited: maximum weight ½ oz., maximum length, 1¾ in.

Gries also has full facilities for secondary operations such as tapping, drilling, assembling, reaming, special machining and surface finishing. Practically all commercial finishes can be applied to GRC zinc alloy die castings.

See GRC at NAT'L METAL SHOW—on stage

BOOTH 550

WORLD'S FOREMOST PRODUCER OF SMALL DIE CASTINGS

GRIES

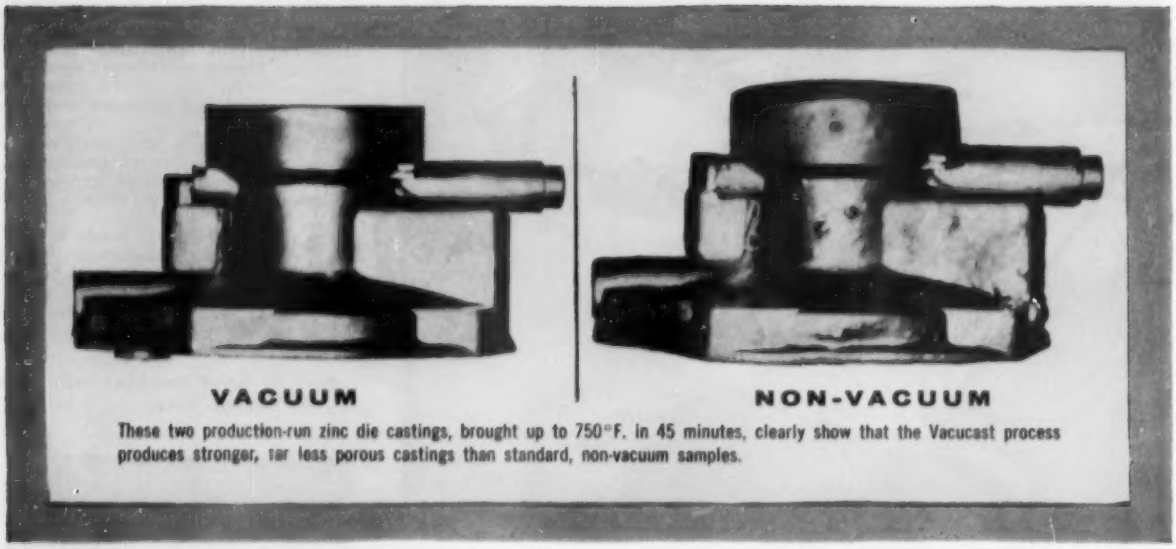
GRIES REPRODUCER CORP.

157 Beechwood Ave., New Rochelle, N. Y. NEw Rochelle 3-8600

For more information circle No. 102 on the Reader Service Card

New Reed-Prentice Vacucast Process Gives

DENSER, STRONGER ZINC CASTINGS!



VACUUM NON-VACUUM

These two production-run zinc die castings, brought up to 750°F. in 45 minutes, clearly show that the Vacucast process produces stronger, far less porous castings than standard, non-vacuum samples.

Here's a big, new improvement in zinc die casting – the Reed-Prentice Vacucast system. Offered as original equipment *only* on REED die casters, this new vacuum casting process gives you higher quality castings than were ever possible before, and at a lower cost.

Exhaustive testing, conducted on Vacucast zinc castings by an independent testing laboratory, show the superiority of this new process. Here are some of the advantages you get with this new vacuum die casting operation:

- Up to 20% faster cycling
- Rejects cut by 50%
- Surface quality improvement greatly reduces polishing and buffing
- Increased hardness and strength, less permeability
- Porosity practically eliminated
- As much as .02" greater skin thickness in thin castings
- Big metal savings through permissible reduction in wall thickness
- Can use existing dies without alteration

ALUMINUM DIE CASTING TOO!

Now under final development and test – a new aluminum self-feeding Vacucast machine process. Watch for an announcement by Reed-Prentice for this newest engineering advancement.

To get complete information on the new Vacucast process, write today to Reed-Prentice Corp., 677 Cambridge Street, Worcester 4, Mass.

REED-PRENTICE

Affiliate of PACKAGE MACHINERY COMPANY

WORCESTER 4, MASS.

BRANCH OFFICES: NEW YORK • CLEVELAND • CHICAGO • BUFFALO • DAYTON • DETROIT • KANSAS CITY • LOS ANGELES REPRESENTATIVE: MINNEAPOLIS—CHAS. W. STONE CO.

For more information circle No. 65 on the Reader Service Card

PMM BETWEEN THE LINES

the editor's viewpoint on articles in current and forthcoming issues

WHAT METALS ARE AVAILABLE if you want to use one of the PMM casting processes? An almost unlimited range of metals and alloys is being cast by one or another of these precision processes, and it may be just a question of choosing the right process to cast the alloy you need. To help you pick the alloy and the process, PMM has tabulated composition and properties of a large number of materials commonly cast by die casting, investment casting, permanent mold, plaster mold or shell mold, and presented them as a reference piece in this issue. It does not pretend to be complete, but is intended only to be representative of what's available. If you need more detailed information on a specific alloy and whether or not it is suitable for your application, we suggest you check with your supplier.

BASIC WORK ON BEARINGS intended for the higher temperatures being encountered in today's aircraft structures, is reported in this issue of PMM. It is doubtful that a satisfactory two phase material could have been developed to meet this rigorous service if it were not for the technical advances in powder metallurgy. The ability to combine two metals which could not be satisfactorily mixed by melting and casting, has produced a blending of properties not otherwise attainable.

DIFFERENCES OF OPINION STILL EXIST among designers of business machines on the relative merits and economies of using powdered metal parts. We wondered whether some of the major business machine companies who don't use powdered metal parts, except for bushings, had missed the boat, and so have collected a report on the experiences of several major business machine manufacturers who *do use* powdered metal parts. The type of components they use and some of the background information is presented in this issue.

WILL A CHANGE TO FUEL INJECTORS mark the end of the large scale use of die castings in the fuel systems of tomorrow's automobiles? Carburetors are an important use for zinc and aluminum die castings now, but will there be as many die castings in the fuel injectors being designed as original equipment for the cars of the future? That question is now being explored by PMM's editors, and the findings will soon be presented in a special report.

HOW TO CLEAN DIE CASTINGS, a relatively simple but crucial process that can be the key to successful plating, will be covered in an article in the Finishing Section of PMM next month.

MACK TRUCK Specifies Epco INVESTMENT CASTING for Vital Part

Bulldog Symbol of Mack Trucks Sturdiness and Dependability

"EPCO Cast lever used by Mack Diesel trucks and buses on hydraulic governor control."

INVESTMENT CASTINGS IN ANY CASTABLE ALLOY EXCEPT MAGNESIUM

Mack engineers specified an EPCO Investment Casting on the above part that was previously machined from ½ inch flat stock.

EPCO Cast in SAE 1045 steel ready for use except for tapping of ¼-20 thread, the lever was made at less cost and well within Mack's high quality standards.

EPCO Cast levers have been in constant use since 1947, and have performed with the same rugged dependability expected in a Mack Bus or Truck.

Get an EPCO quotation before machining or assembling your intricate parts.

Representatives Wanted for Philadelphia, Baltimore and Mid-West.

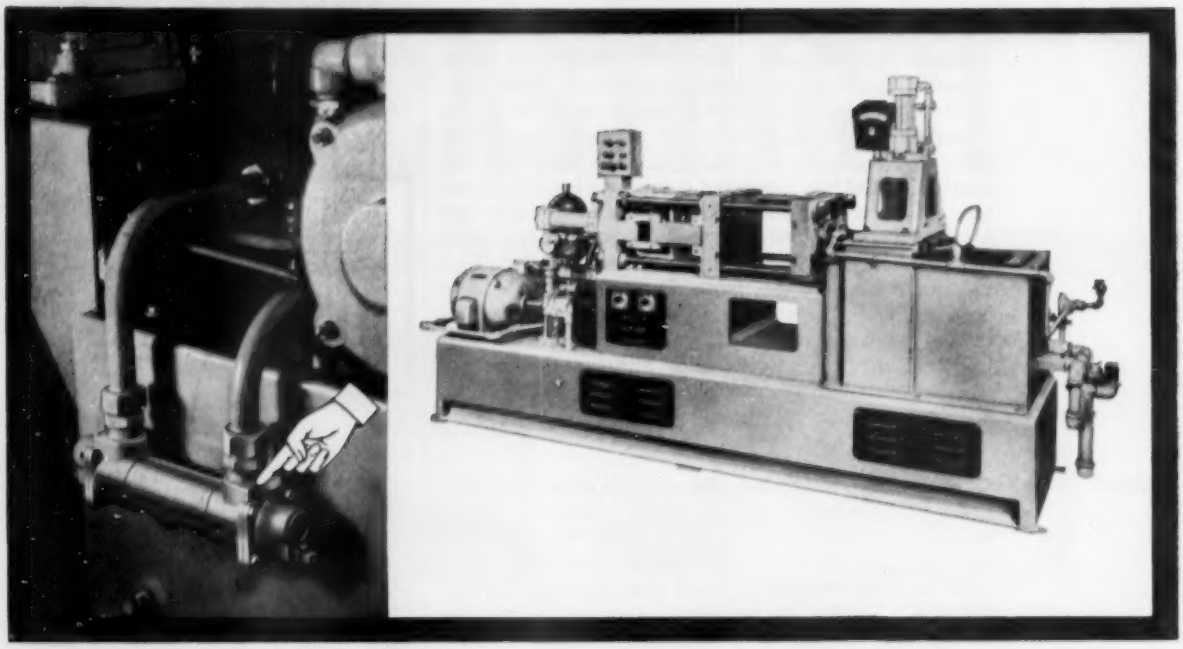
Epco ENGINEERED PRECISION CASTING CO.

FREEHOLD RD.
MATAWAN, N. J.

Circle No. 34 on Reader Service Card

ROSS EXCHANGER

standard on American Die Casters



"to avoid shut down for cooling off"

Cycling up to 700 shots per hour, this American Die Casting Machine produces fine hardware finish castings weighing up to 2½ lbs. Safeguarding its capacity for continuous, high speed operation, a Ross Type BCF Exchanger holds hydraulic fluid temperature in check.

Says American Die Casting Machinery Co., "Ross Exchangers are installed as standard equipment on our machines to avoid any possibility of the operating efficiency being impaired by excess heat or the necessity of the slightest shut down for a cooling off period."

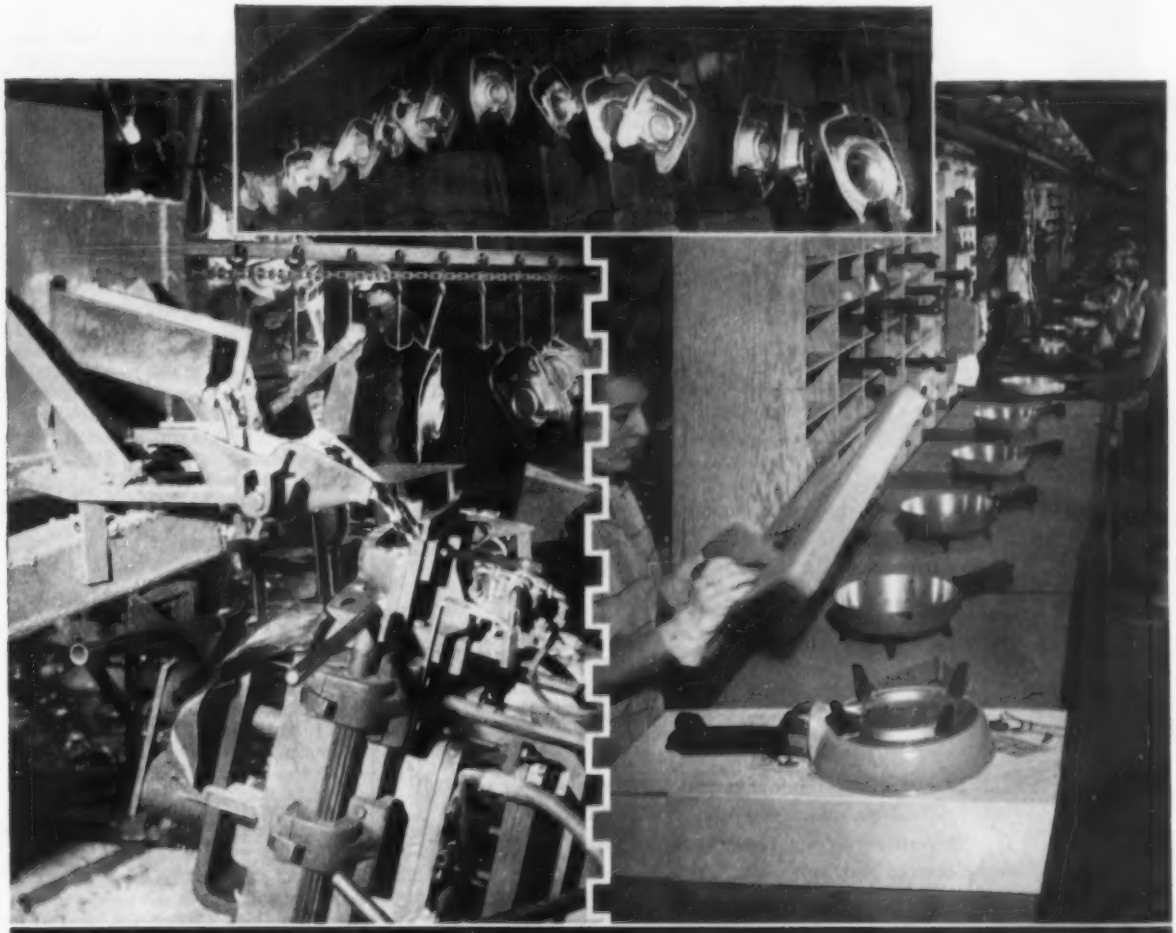
When you see a die caster, metal drawing press or any hydraulically-operated machine equipped with a Ross Exchanger, you can be sure that its builder has provided the most dependable temperature protection obtainable. Ross Exchangers are not only top rated for thermal efficiency, but they're ruggedly built to withstand punishing hydraulic shock.

Compact in design, easy to install and easy to maintain, they're pre-engineered and fully standardized in a wide range of sizes.

For detailed information, request Bulletin 1.1K5. Ross Heat Exchanger Division of American-Standard, Buffalo 5, N.Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

For more information circle No. 8 on the Reader Service Card

MONARCAST* ALUMINUM PERMANENT MOLD PRODUCTION IS GEARED TO MASS-ASSEMBLY LINE DEMANDS



MORE CASTING VALUE PER DOLLAR

The aluminum permanent mold process is a mass production method—at Monarch. High volume foundry operations have been pioneered by Monarch to gear a steady flow of castings to your mass-assembly line requirements.

Monarcast* methods provide highest quality metal structure, superior strength and dimensional accuracy. Flexibility of production operations is achieved, even during periods of product modification.

Monarch's unique finishing services featuring Velvaglaze* and Spectraglaze* give you "one source" responsibility from rough castings through finished components.

"Non-competitive" experience in both aluminum permanent mold and aluminum and certified zinc die castings offer you factual answers on the right methods to obtain highest quality at lowest product end-cost.

SINCE 1913
MONARCH ALUMINUM
PIONEERS IN CASTING PROGRESS

* Velvaglaze, Spectraglaze and Monarcast are Trade Marks of

MONARCH ALUMINUM MFG. COMPANY—9205 DETROIT AVENUE—CLEVELAND 2, OHIO—OLympic 1-1700

MANUFACTURERS OF: *Aluminum Permanent Mold Castings • Zinc Die Castings • Aluminum Die Castings • Exclusive Velvaglaze Finishing • and Spectraglaze, colorful Porcelain Enamel on Aluminum Permanent Mold Castings.*

For more information circle No. 54 on the Reader Service Card

Mossberg had 5 REASONS for using . . .

4 HITCHINER INVESTMENT CASTINGS in this new shotgun*. . .

1. PRICE: These four intricately shaped parts could not be machined within cost budgets. HITCHINER Investment Castings were well within the budget allowed.

2. STRENGTH: If machined, choice of metals was limited to those easily worked. HITCHINER Investment Castings requiring little or no machining, offered a wide variety of alloys permitting greater strength at no additional cost.

3. TIME: Production speed was essential in introducing the new gun. HITCHINER, by using comparatively inexpensive one-cavity dies for the original run, helped get the gun on the market on schedule. Later, multiple-cavity dies were used.

4. DESIGN: The four key parts as designed posed difficult manufacturing problems. The HITCHINER Investment Casting process permitted wide latitude in contour and form.

5. APPEARANCE: Obviously components must maintain the appearance of quality in any quality product. HITCHINER produced accurate parts attractive in appearance without extra work or cost.

These are reasons why so many use HITCHINER Investment Castings to solve small parts problems in both small and large production runs . . . send us your drawings and all pertinent data.

A 12 page booklet covering cost, design, application and manufacture of HITCHINER Investment Castings is yours for the asking . . . send for it TODAY.

*The gun is one of the new No. 200 series Pump Action Shotguns manufactured by O. F. Mossberg and Sons, Inc., 998 St. John's St., New Haven 5, Connecticut.

HITCHINER
Manufacturing Company
MILFORD 7, NEW HAMPSHIRE
REPRESENTATIVES IN PRINCIPAL CITIES

For more information circle No. 38 on the Reader Service Card

PMM PEOPLE

changes & appointments

Richard M. Smith has been appointed production superintendent of the refractories plant at *Corning Glass Works*. Mr. Smith succeeds **George W. Rogers** who has been named project engineer in charge of the special process development program handled by the refractories division development laboratories.

Thoburn P. Sands and **William B. Hicks** have been appointed section managers in the development department of *Monsanto Chemical Co.'s* organic chemicals division. Mr. Sands will manage the department's petroleum chemicals and functional fluid section and Mr. Hicks will handle the plasticizers, resin materials, and paper chemicals section. Mr. Sands and Mr. Hicks will share the former responsibilities of **George R. Buchanan, Jr.** who has been appointed associate manager of the division's petroleum chemicals sales group.

The appointment of **Maynard H. Patterson** to vice president and general manager of the International Division of *Minnesota Mining & Mfg. Co.* has recently been announced. Mr. Patterson held a similar position with Minnesota Mining & Mfg. of Canada, Ltd. **Kenneth J. Shea** has been named to Mr. Patterson's former position. Mr. Shea was vice president and general sales manager of the International division.

R. A. Colton, an engineer with *Federated Metals Div., American Smelting & Refining Co.*, was recently elected chairman of the Metropolitan chapter of the American Foundrymen's Society for 1956-57. At present, Mr. Colton is a member of the executive committee of the Brass and Bronze Division of the Society.

Dr. A. Eugene Schubert, manager of engineering for *General Electric Co.'s* chemical materials department, has been named manager of the company's chemical development department.

Dr. W. H. Millet has been appointed sales manager and **M. A. Bigelow, Jr.** has been named assistant sales manager, Ucon products, for *Carbide & Carbon Chemicals Co.*, a division of Union Carbide & Carbon Corp.

National Research Corp. has named **John H. Durant** as director of public relations. Prior to the new appointment, Mr. Durant was business manager of the corporation's research division.

The appointment of **Howard Hill** as sales and service representative of the Ionic Spray Division of Scientific Electric has been announced. Mr. Hill will be stationed at Scientific Electric's laboratory in Garfield, N. J.

The recent appointment of **L. P. Best Co.** as Washington, D. C. representative for Ohio Hoist & Mfg. Co., Inc. and Alcaloy, Inc. has been announced by *Dickey Industries*. Ohio Hoist and Alcaloy are affiliated with other companies under the Dickey Industries banner.

New appointments in the refractories division sales department of *Corning Glass Works* are **Kenneth E. Holley** as senior applications engineer and **Paul V. Lovette** as sales engineer. Mr. Holley was formerly supervisor of special refractory production and Mr. Lovette was associated with the glass technology department of the manufacturing staff division.

Lewis J. Pentland, Evan E. Graham, and **Henry B. Puff** have been named district sales managers for New York, California, and Chicago, respectively by *Durez Plastics Div., Hooker Electrochemical Co.*

Kelite Products, Inc. has named **Charles N. Chalfant** as district sales manager for the New York district and **Robert J. Racine** as Western regional sales manager.

Chemical & Industrial Sales, Ltd. has been appointed sales-engineering representative for *Conoflow Corp.* to handle markets in Alberta and Saskatchewan provinces in Canada.

Richard A. Steenrod has been appointed materials engineer for the silicone products department of *General Electric Co.* in Detroit. Mr. Steenrod will aid design, process, and product engineers in proper application of all types of silicone materials.

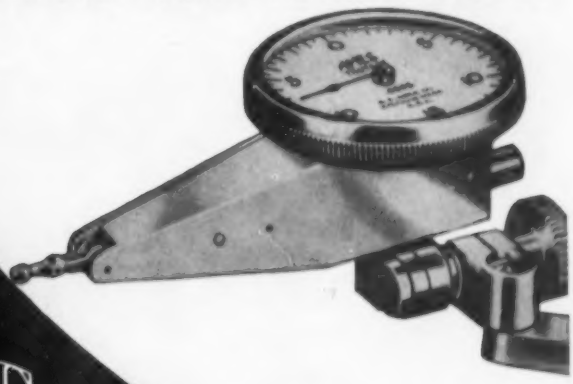
Scully-Jones & Co. has appointed **Ekedahl Tool & Supply Co.** as distributor of the Scully-Jones line of precision tools in southwest Pennsylvania, northern West Virginia, East Liverpool, Ohio, and several eastern Ohio counties. Scully-Jones also named **Service Industrial** as distributor in San Diego and Imperial counties, California.

John V. E. Hansen has joined the staff of *National Research Corp.* as administrative assistant to the director of research.

Jack Keyes has been elected vice president in charge of western Michigan sales for *Wagner Bros., Inc.* At the same time, **Richard Watson** has been appointed by the company as office manager of a newly established factory branch in Grand Rapids, Mich.

Continued on page 75

...to obtain cost reduction...



AMES uses HITCHINER precision investment castings

The B. C. Ames Co., Waltham, Mass., producers of some of the world's most accurate micrometer dial gauges, is another leading manufacturer who has found that accurate HITCHINER INVESTMENT CASTINGS reduce production costs by eliminating expensive machining operations. The Ames "Trutest" case is a typical Hitchiner bronze casting held to such close tolerances that finishing operations are kept to a minimum. To make this part from the solid or to use another type of casting would mean prohibitive expense, according to the Ames Company.

HITCHINER INVESTMENT CASTINGS permit, with only a few exceptions, complete freedom in the choice of ferrous or non-ferrous metals. The Ames Company chose beryllium copper for the clamp castings to gain proper metal density, freedom from fatigue, and longer life at much lower costs than machined steel clamps.

If you use small castings, your company, like Ames and many others, may be able to cut cost of components through HITCHINER INVESTMENT CASTINGS. We'll be glad to furnish prompt quotations on receipt of your prints. WRITE FOR FREE BOOKLET TODAY TO —

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Representatives in principal cities.

For more information circle No. 38 on the Reader Service Card

"THERE'S A REASON FOR OUR ENTHUSIASM . . ."

"Our H-P-M's Give Us Better Quality Castings and Less Scrap . . . Consistently"

Kiowa Corporation, Marshalltown, Iowa, says, "The advanced principles of the H-P-M die casting machines have solved many of our quality problems and our day-to-day die maintenance problems have been reduced. We have two 200 ton, two 600 ton and another 600 ton H-P-M on order."

The new H-P-M die casting machines offer unlimited possibilities for die casting improvements. Here are the reasons: H-P-M's link wedge mold clamp locking mechanism pre-stresses the machine frame so that when metal is injected at high speeds and pressures, the mold is firmly clamped. Frame deflection is minimized due to the "beef" in platen and tie rods. Casting dimensional tolerances and density factors are held; flash is reduced to the minimum; scrap loss is practically nil.

Another important advancement, H-P-M's injection speed control, is infinitely adjustable for acceleration, high speed and pressure follow-through. Intricate detail is accurately reproduced; surface finish is greatly improved; pressure follow-through packs metal for high density.

Remember—for top quality die castings . . . better density control . . . uniform finishes . . . less scrap . . . more year-'round success and satisfaction—H-P-M die casting machines are 'way ahead of the field. Write for Bulletin 5400-J and get the complete facts.

HPM

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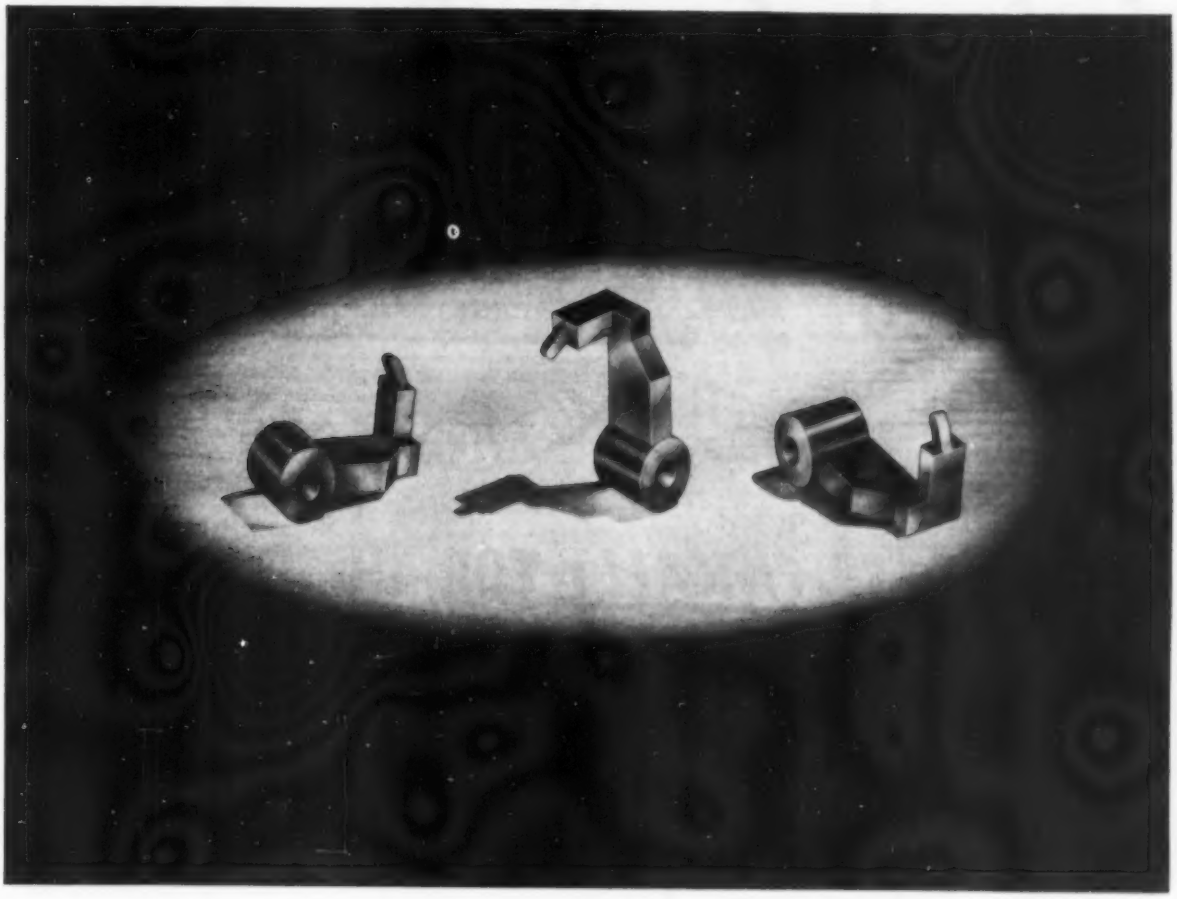

Impossible in Powdered Metal? Not at PARKER

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Girard L. Palmer • Belden Hill Road

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J. C. Palmer • 712 State Tower Bldg.

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Warren G. Olson • 420 East Linn Street

This part—with projections in several planes, not to mention an I.D.-O.D. section—looked like an impossible job for powdered metal. Yet Parker made it in **one press operation**—complete—to close tolerances and tight "specs"—at relatively **low cost.**

This unusual piece points up the advantages offered by Parker powdered metal processing. Tough cost problems of conventional casting and machining methods often can be solved. Tensile strength, ductility and impact resistance can be closely controlled to meet rigid specifications. Powdered metal constituents can be precisely and uniformly blended for a wide range of requirements.

Parker's experience and facilities in producing a wide variety of powdered metal parts have saved money—and solved problems—for many users. Your problem may be one that Parker can solve in like manner. Just call the nearest Parker sales engineer listed at the left.

Parker White Metal Company • 2153 McKinley Ave., Erie, Pa.

PARKER

POWDERED METAL PARTS
ALUMINUM and ZINC
die castings

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For Smoother Separation, Cleaner Surfaces

SWITCH TO DI-ALUBE

DIE-CASTING LUBRICANTS

DESIGNED *SPECIFICALLY* FOR THE INDUSTRY!

DI-ALUBE ASSURES:

MAXIMUM QUALITY!

- Eliminates gassification and porosity
- Finer finish, minimum stain and discoloration
- Minimum core drag
- Non-Toxic — Less Smoking — No Odor
- "Prescription — Perfect" uniformity assures non-varying performance

MAXIMUM PRODUCTION!

- Smooth, no-stick separation
- Unequalled metal flow and fill-out
- Minimum soldering
- Cleaner cavities, cores and pins
- Minimum scrap and down-time

MAXIMUM PROTECTION!

- Excellent film strength
- Non-injurious to die surfaces
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- Ends build up on dies and pins
- Eliminates heat break-down in lubricant

The DI-ALUBE formula is a matchless blend of superior lubricants ***specifically designed*** to produce the smoothest, cleanest die castings in the trade — and to provide maximum ease of separation, speed of production and minimum down-time. Vastly superior to "all purpose" lubricants, DI-ALUBE is the answer to YOUR die casting problems.

Developed and production-proved in one of America's largest industrial areas new DI-ALUBE is the preferred lubricant in the majority of mid-west die casting plants. A test run will prove its superiority in your operations.

DI-ALUBE does more than promise — **it produces!** Given a good die to work with DI-ALUBE will give you the smoothest, cleanest pull-away you've ever experienced, together with finer, stain-free castings.

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SWITCH NOW TO NEW DI-ALUBE — THERE'S A "PRESCRIPTION-PERFECT" GRADE FOR EVERY JOB!

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PMM LETTERS

the readers' forum

COLOR ANODIZING AGAIN

Our production engineer has brought to my attention "Interest in Color Anodizing" in your letter to the editor column. We are extremely interested in this inasmuch as we are the largest manufacturer of office equipment hardware in the country; 95% of this hardware is aluminum, either sand cast, wrought or die cast.

We would appreciate establishing contact with the New England Die Caster with regard to color anodizing.—L.S.C. (Sales Manager)

In response to the continuing interest in this subject, PMM last month published a first report on the new anodizable aluminum alloy which can also be die cast. Composition and complete properties of this new alloy were published. As more data on this development, or any others in the direction of practical color anodizing of die cast aluminum, are available, they will be reported to PMM's readers.—Ed.

INVESTMENT CASTING DIRECTORY

Your June 1956 issue of PRECISION METAL MOULDING included a "First Annual Investment Casting Directory".

In our Corporation we have several Divisions vitally interested in the purchase of investment castings. A directory such as this would be a valuable publication in the hands of our specialized Buyers.

Have you published, or do you anticipate publishing this directory in pamphlet form? I would appreciate further information on its availability and cost at your earliest convenience.—J. T. (Associate Director of Purchases)

Requests continue to come in for more copies of our first directory of the investment casting industry. Although we ordered a sizeable over-run to meet the expected demand, it fell far short and our supply was completely exhausted in two or three weeks.

Continued on page 106

There's safety in these NEW numbers

UCON BRAND **Hydrolube 150-CP**
(Viscosity—approx. 150 S.U.S. at 100° F.)

UCON BRAND **Hydrolube 275-CP**
(Viscosity—approx. 275 S.U.S. at 100° F.)

Yes, there's safety in these two new grades of UCON Hydrolubes —CARBIDE's safety hydraulic fluids.

Greater safety for machines

These new UCON "CP" Hydrolubes...

- Contain improved liquid and vapor phase corrosion inhibitors for the common metals.
- Have good lubricity. Special anti-wear agents provide improved pump life and performance characteristics.
- Have high viscosity indexes—150 to 160.
- Have low pour points—can be used at sub-zero temperatures.
- Have no harmful effects on packings and seals. Leakage losses are often lower than with other hydraulic fluids.
- And, are made in the two standard viscosity grades—others can be supplied to fit specific requirements.

Safety for men and property

- The resistance of UCON Hydrolubes to burning has been proved by years of exhaustive testing in the laboratory and, by more than 8 years of practical application under standard industrial conditions. UCON Hydrolubes are water-base hydraulic fluids—the water content is the key to their fire-resistance.
- And, for all practical hydraulic purposes, UCON Hydrolubes are non-toxic to workmen.

For safety's sake, get all the facts. Write *today* for the new booklet, "UCON Hydrolubes Spell Safety," Form 40134.

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A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

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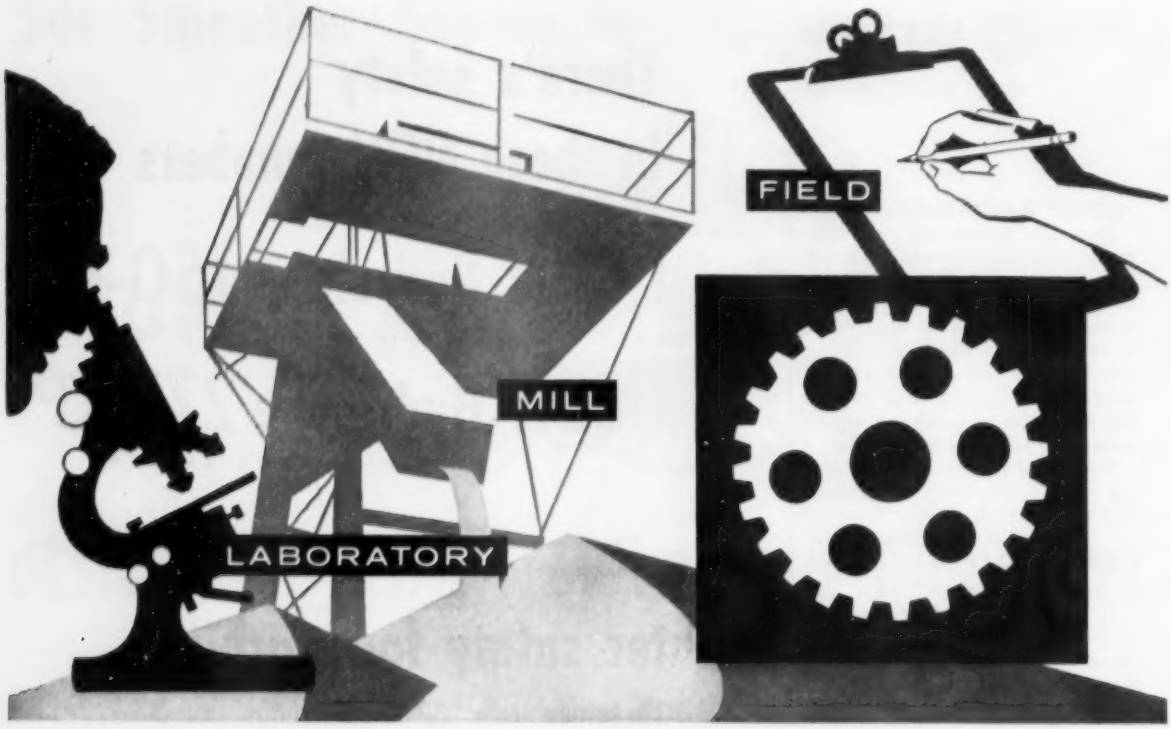

Republic's 3-Step Metallurgical Service

NOW AVAILABLE TO DESIGNERS AND FABRICATORS OF IRON POWDER PARTS

What Is It? 3-Step Metallurgical Service combines the experience and knowledge of Republic's Field, Mill and Laboratory Metallurgists with the skills of your own engineering and designing staffs.

How Does It Work? In the design or fabrication of an iron powder part you may encounter a problem involving one or a combination of factors, such as mechanical and physical properties, capabilities and limitations, or plain economics. The Republic Field Metallurgist studies the problem, right in your plant. He talks to your designers and engineers, asks questions, finds out what you want iron powder to do. His report goes to the Republic Mill and Laboratory Metallurgists.

These three men discuss the report—pool their combined knowledge of iron powder—check it against your problem. Their final recommendation, based on solid data, is passed on to your engineers by the Republic Field Metallurgist. He stays on the job, works with your personnel to see that the problem is solved to your satisfaction.

How Do You Benefit? The recommendations of these Republic specialists can help you determine iron powder's suitability to your parts design. If Republic Iron Powder does not lend itself to your particular application or is less economical in comparison to other methods of fabrication we will tell you so—and then suggest alternate methods or materials better suited to your requirements.

What Does It Cost? Republic's 3-Step Metallurgical Service is free. You can have it by calling your local Republic Steel sales office, or by mailing the coupon.

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IT'S REPUBLIC IRON POWDER WITH cdf

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Next month we will tell you what it is—what it does—what it means to you as a designer, producer or buyer of iron powder parts.

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WESTINGHOUSE

and others . . .

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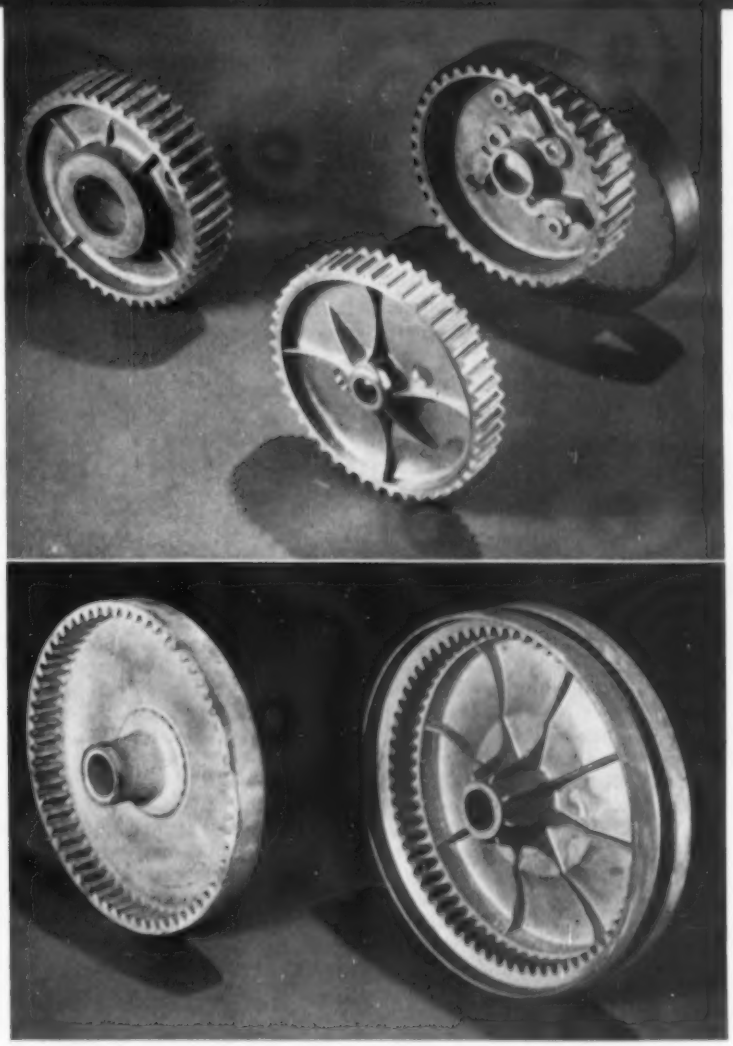
DIE CASTINGS



Gears In Light Metals

TEETH WITHOUT DRAFT can be die cast in magnesium. The cog belt gears, top, are examples of this. On the other hand, the internal gears for lawnmower wheels, shown below, must have a small draft. The one on the left is in magnesium; the one on the right is aluminum, and includes a peripheral groove for the lawn mower tire.

may meet some special needs in your products

WHY use aluminum or magnesium die cast gears? These alloys have certain characteristics worth considering when you are designing the gears for your product.

Where there are likely to be special problems relating to draft on gear teeth, corrosion resistance, weight, accuracy or appearance, one of these alloys may help to avoid design difficulties. If you have already decided that a die cast gear in place of a machined or hobbed one will save you money, there are specific applications in which the light metal alloys are most suitable.

The trend today in many types of products, whether or not they are intended to be portable, is to make them as light in weight as possible. Many manufacturers of business machines, household appliances, yard and garden equipment, engines and control devices are lightening their products, just as the makers of portable tools, aircraft instruments and photo equipment have always done. Here, aluminum and magnesium are desirable.

Sometimes, for operation under special conditions such as exposure of marine apparatus to salt atmosphere, an aluminum alloy will be the preferred material; on the other hand, installations where sound damping is a factor make good use of the properties of magnesium.

In the majority of cases, where functional requirements have been met adequately, cost is the

Continued on page 99

Combining a very hard material with one having properties of a metallic liquid lubricant would have been an impossible job if it were not for the powder metallurgy techniques for combining dissimilar materials.

Wear Behavior Of High Temperature Bearing

By DR. JOHN T. BURWELL
Vice President
Horizons, Inc.

THE gas turbine presents special problems, as has the entire concept of supersonic flight. One such problem . . . the development of a material suitable for bearing retainers used in aircraft gas turbines . . . was presented to Horizons Incorporated by the Wright Air Development Center, Air Research and Development Command. Part of the project consisted of a study of the wear behavior of several classes of potential materials.

Three basic findings evolved from the study:

1. Several heterogeneous alloys containing silver as a soft, low shear strength phase, showed wear properties significantly superior to "S" Monel and iron-silicon bronze, even when silver plated. The latter alloys are presently used as cage materials in jet airplanes.
2. The hard, load-supporting phase showing the most promise was a nickel base material with additives of silicon or silicides.
3. The materials showing the best wear properties were most efficiently fabricated by powder metallurgy techniques, utilizing infiltration for adding silver.

While it is understood that generally the present materials used for such cages i.e., silver plated iron-silicon bronze and "S" Monel, are satisfactory, the evidence indicates that they are operating at their very upper temperature limits with no margin of safety.

A wide variety of other metallic materials have been tested in the past, such as brass, bronze, nickel base alloys, and various types of cast irons. The cloth impregnated plastics, which have been useful in conventional applications of roller and ball bearings, are ruled out by the high ambient temperatures to which the cages are exposed.

What is required to prevent cage failure?

While the mechanism of cage failures is not understood exactly, the available evidence indicates that adhesive metal transfer between the cage and race materials plays a major role in the process. The resulting clearance alterations can then lead to failure in several different ways. It is evident, therefore, that major criteria in the selection of a retainer material are its frictional characteristic and its surface stability against hardened alloy steel.

A consideration of the mechanism of adhesive friction and wear, as it is presently understood, suggested the use of a two-phase system for the friction surfaces of the cage or retainer. This two-phase system would consist essentially of a hard phase which would limit the size of the true contact area while contributing the desired bulk strength properties and a soft, low shear strength phase which would act as a metallic film lubricant.

This view permitted a wide variety of material combinations to be considered, both metallic and non-metallic.

On the assumption that the primary problem is galling or metal transfer, the factors that are responsible for it must be considered. The modern theory of friction ascribes its orgin almost entirely to minute adhesions or welds between the solid surfaces. On this theory, it is possible to predict semi-quantitatively the conditions for low adhesion and for low friction. The conditions for low adhesion are essentially that: (1) the true area of contact be as small as possible or, in other words, that both surfaces be hard and (2) that the materials of the rubbing surfaces be chemically as dissimilar as possible.

At low rubbing speeds, even though the friction will not necessarily be low, these conditions are usually sufficient to prevent adhesion. However, at high rubbing speeds, the friction itself, although it does not necessarily result directly in much adhesive transfer of material, does have an important indirect effect. This is the frictional heat evolved which produces appreciable softening of the surfaces thus increasing the true contact area and also accentuates any tendency to weld.

A weak bond, in turn, is achieved primarily through the chemical dissimilarity between two surfaces, resulting in low adhesion. This has been shown to depend on the mutual solid solubility for the other surface, or tendency to solid-phase weld. However, experiments using radioactive tracers have demonstrated that even between the most dissimilar materials, such as steel and glass and using the best boundary lubricant, some adhesion and transfer of material still remains.

It is, therefore, further required for a weak bonding layer that it consist of a material that is in-

Materials

herently weak itself, i.e., it should be soft at the temperature of operation, and have a melting point not much above this temperature, so that any frictional heating will produce a locally liquid surface layer and resist any further temperature rise.

The basic mechanism underlying adhesive wear is not understood in as much detail as that of friction. However, previous research indicates that it also depends on the true area of contact as well as the load and distance of travel. It has been shown that for homogeneous materials, at least, the character of the wear changes markedly above a critical load becoming self-accelerating and catastrophic, completely destroying the surfaces.

Advantages of a 2-phase material

It appeared rather certain, therefore, that a successful material for gas turbine bearing retainers must possess a duplex surface structure. It is very doubtful whether any single material could have all the requisite properties. On the other hand, a duplex or two-phase material offers a double range of choice of material properties for obtaining a successful result. This is, in fact, the situation with all the premium bearing materials for high-speed, high-load applications today such as babbitts, copper-lead, lead-indium coated silver, copper-graphite, silver-tungsten, etc.

On this premise, the principal requirements of the soft material

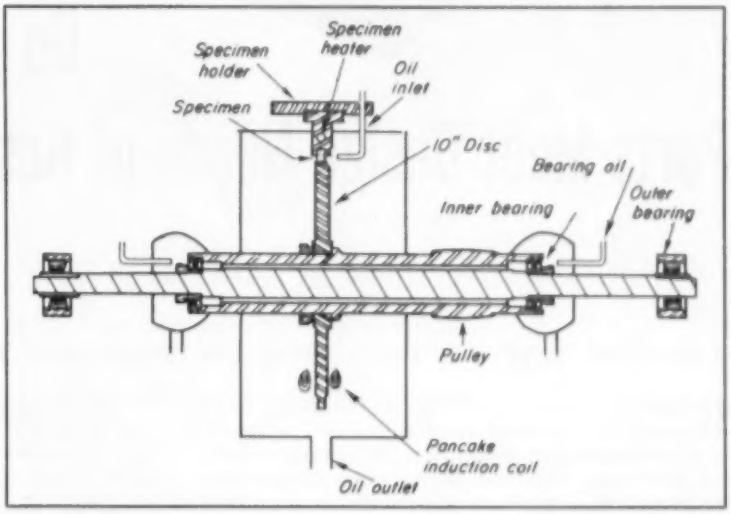
Continued on page 87

MATERIALS TESTED: Here are nine of the most significant.

Weight Percent Composition									
Cr	25.8	24.7	24.3						
Ni	25.8	24.7	24.3				64.7	61.9	59.8
Monel				62.3	61.0	59.5			
Si	2.1	4.3	2.0	2.5	4.9	4.0	2.6	5.4	2.5
Mo			3.4			4.3			4.2
Ag	46.3	46.3	46.0	35.2	34.1	32.2	32.7	32.7	33.5

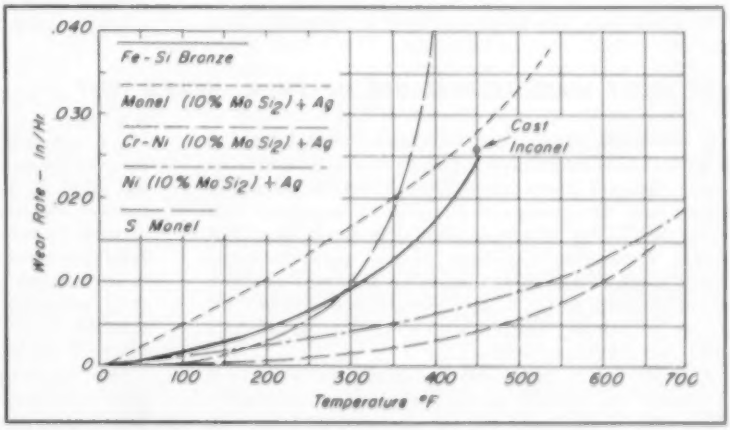
TWO-PHASE MATERIAL with nickel or nickel alloy base, infiltered with silver or silver alloy, provides the most effective combination. Here are some of the most promising materials tested.

TEST SETUP: Simple device simulates actual service.



RESPONSE TO WEAR, heat, friction and other conditions are revealed by this testing apparatus. Excessive wear, surface scoring, excessive friction or heat build-up, vibration, are among the conditions observed.

RESULTS: Here is the scoreboard.



RELATIVE WEAR RATES of potential cage materials are shown here, as a function of temperature.

Do Powdered Metal Parts Meet Design Needs of Business Machines?

A HANDFUL STILL ARE USING NONE FOR STRUCTURAL PARTS . . .

BUSINESS machines are considered prime consumers of powdered metal parts, used as structural or engineering components (as contrasted with self lubricating bushings). In surveying the business machines field, however, it is found that an important group of manufacturers do not use powdered metal parts. Among these are some of the largest, particularly in the field of adding and calculating machines. Where the size, shape, kind and number of parts used are relatively standard, some companies use large numbers of powdered metal parts while others find that they are not applicable.

For example, one large mid-western manufacturer of calculating machines who uses hundreds of duplicate parts per machine has been unable to discover the economies of powder metallurgy. In another case, a major manufacturer of dictating equipment reported that it has investigated the possibilities of using powdered metal parts and found that only self lubricating bushings and small magnets can be economically used.

Here, then, would seem to be a likely field for the further expansion of powdered metal parts usage. If some manufacturers find these parts economical, these same economies may be demonstrated to others not now using them.

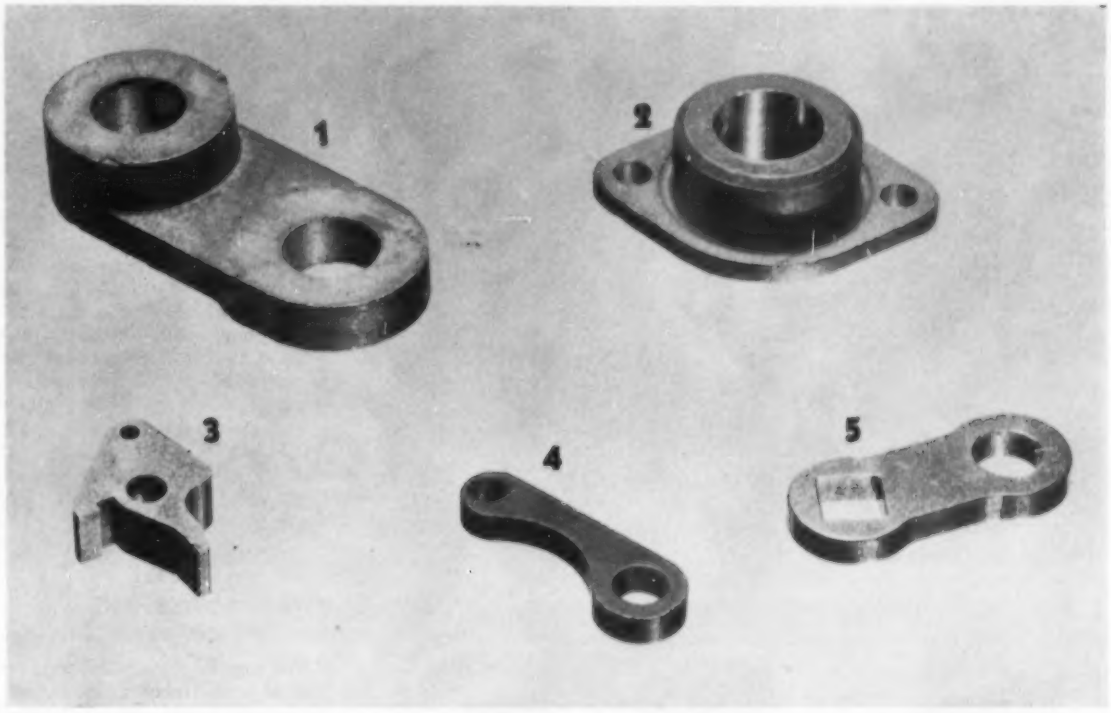
BUT MOST MAKE LIBERAL USE OF THEM. HERE'S WHY . . .

A LARGE number of companies, and here are included some of the giants of the industry, do use structural parts made from metal powders. In every case, this usage is dictated by economy. For example T. W. Turner, chief industrial engineer, Royal Typewriter Co. says of one part currently being used, "The savings made on this new method, using sintered metal, is approximately $45.34 per 100 pieces, which of course, is, a considerable savings over our previous method."

But the use of powdered metal structural parts is certainly not limited to the very large companies. Wherever it has been clearly demonstrated that an economy can be achieved, powder metallurgy has been used. If the business machines field is to get maximum potential value from powder metallurgy, the engineers from the parts producing companies will have to work with the design engineers so that *powder metallurgy can be used as an initial method of manufacture*. Once a part is in production, a considerable amount of money has been spent on tooling; to accomplish a conversion requires that the saving shall amortize the existing tooling. In many cases this can be done, but it is certainly the wiser policy to avoid the high cost of this tooling.

The engineer from the producing company must also be certain that when a cost comparison is made, this comparison is at the same level. That is, machined parts and powdered metal parts must be in the same state of completion, generally at assembly level.

Here are some powdered metal business machine parts . . .



REMINGTON RAND
Accounting and Sorting Machines

These parts represent relatively limited production in the terms that the powder metallurgy industry generally speaks. All of them represent a considerable saving over other manufacturing methods.

1. Support for rotating arm

Arm, Pressure Roll: This part is used in the Electronic Sorter as a bearing for the upper feed and carrier roll shafts which operate at a speed of approximately 800 R.P.M. The part is made of oil impregnated sintered bronze, and was never made by any other process. The vendor for this, and items 2, 4 and 5 is General Powdered Metal Corp.

2. Self-lubrication is a function

Bearing, Lower Roll: This part is used in the Electronic Sorter as a bearing for the lower feed and carrier roll shafts. The shaft rotates at a speed of approximately 800 R.P.M. The part is made of oil impregnated sintered bronze, and was never made by and other process.

3. Redesigned from bar stock

Floating Master Dog, Blank: This part is used in the actuator mechanism on the Remington Accounting Machines, models 500 and 600 series. The part was formerly made from bar stock which necessitated several milling and drilling operations to produce the outline as shown as per the blueprint. The part as now purchased is complete as shown on the print, including both holes which are finished to size in the powdered metal process. The changing of this part from bar stock to powdered metal did not necessitate any change in design. The vendor is Pres-Met Corp.

4. Previously blanked from steel

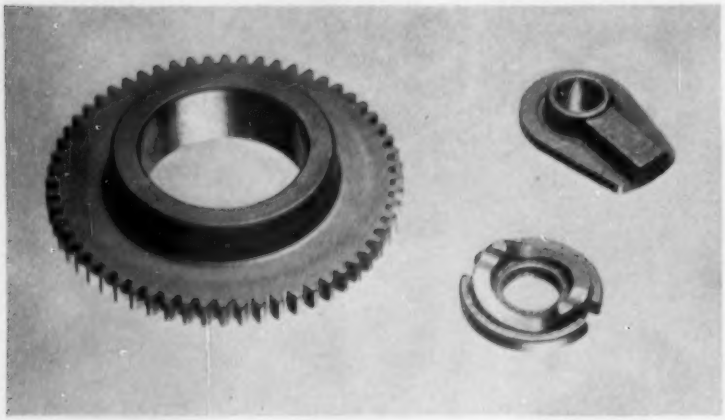
Cylinder Frame Connecting Link. This part is used on the Remington Accounting Machines, 500 and 600 series, and is a tie link between the cylinder and the cylinder frame mounting mechanism. This part was formerly made by blanking, shaving, drilling and reaming and is now furnished complete as shown in powdered metal. The changing of the part from the sheet steel method to powdered metal did not necessitate any design changes.

5. Lower cost than sheet steel

Rear Bail Shaft Tie Piece: This part is used in the Remington Accounting Machines, 500 and 600 series, and is a tie piece between the two bail shafts. This part was formerly made of sheet steel by blanking and shaving. The part is now furnished complete in powdered metal. The changing of the manufacturing method on this part from sheet steel to powdered metal did not necessitate any design changes.

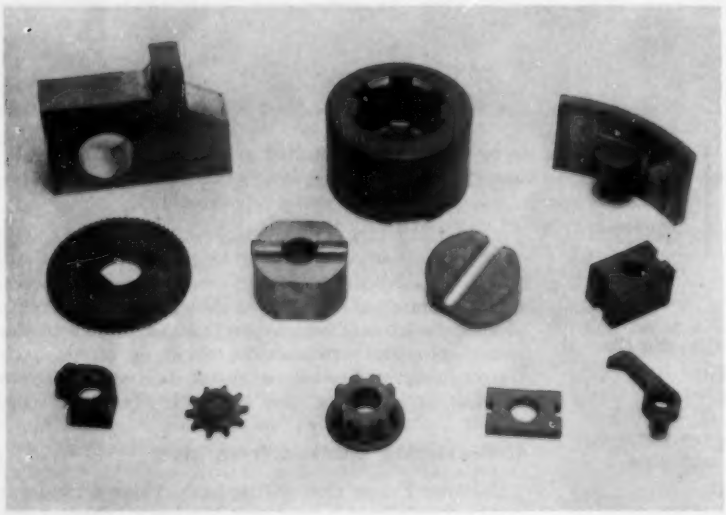
For More Examples Turn The Page

Business machines are major users of powdered metal parts.



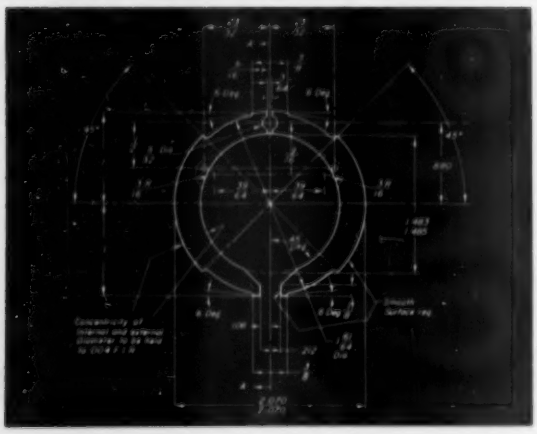
A. B. DICK CO.
Duplicating Machines

At the present time, this company uses three structural parts in addition to a large number of standard self lubricating bushings. All three parts are made by the Amplex Div. of Chrysler Corp. The gear is for the main drive on a spirit duplicator. The cam, or more properly a cam lock, is used on various mimeograph duplicator cylinders. The third part is properly only a bushing, but falls within the scope of non-bushing fabricated parts because of its special design. All three of these parts show cost economies.



PITNEY-BOWES, INC.
Postage Machines

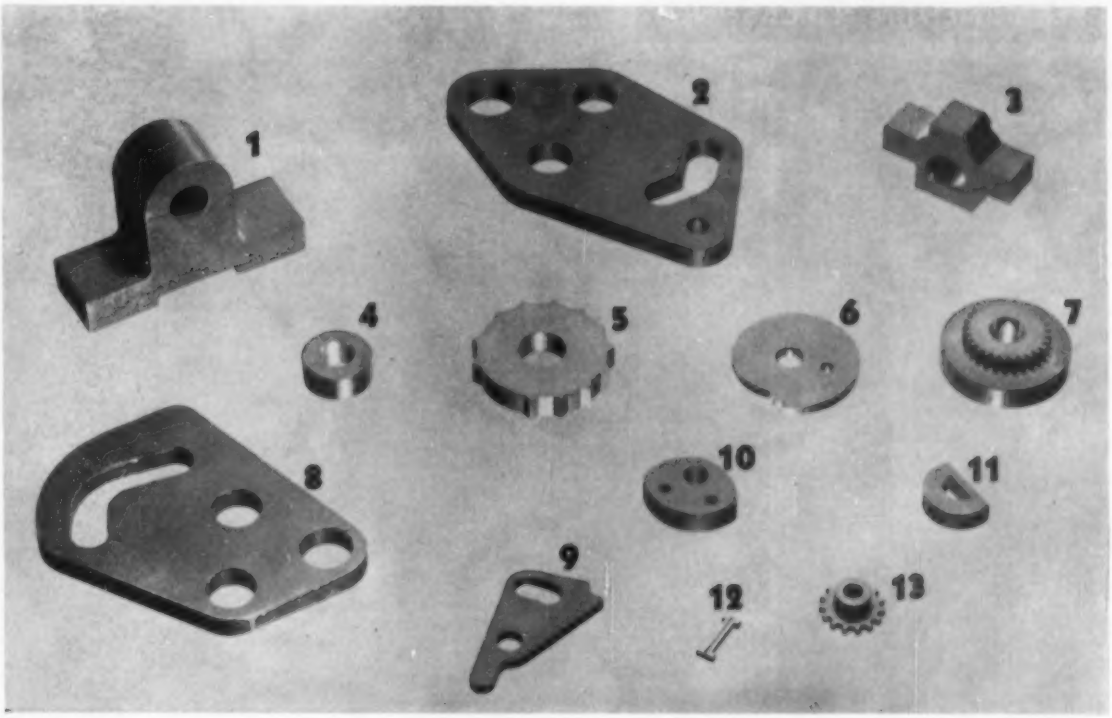
The key to economical production of postal meters lies, in part, in the use of iron powder structural parts. While this is the largest company in its particular field, the number of units produced per year is small when compared with other types of business machines. Yet in spite of relatively limited production, this company has found powder metallurgy to be an economical method of fabrication. Further, this method of parts manufacture has consistently shown economies whether the parts are made by on outside fabricating shop or by an internal shop; the difference is only in degree.



ROYAL TYPEWRITER CO.
Typewriters

To date, this company is using only one structural part made from iron powder. However, the company is ". . . negotiating and investigating several component parts that have possibilities of being produced from sintered powdered metal."

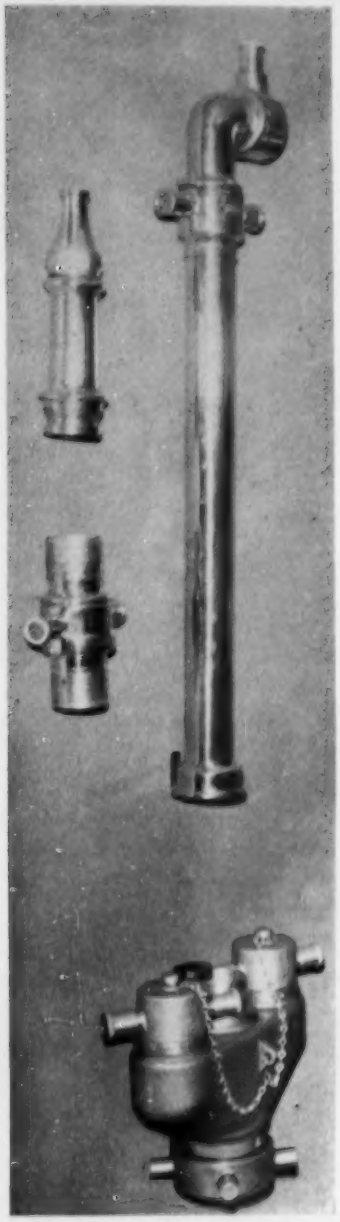
The one part now in use is a clutch expansion shoe made for Royal by Yale & Towne Mfg. Co., Powdered Metal Products Div. The change to powdered iron was from sand casting. In place of ten separate operations formerly employed there are now only three. The change to a powdered metal part has resulted in lowering the cost per part by $45.34 per hundred pieces.

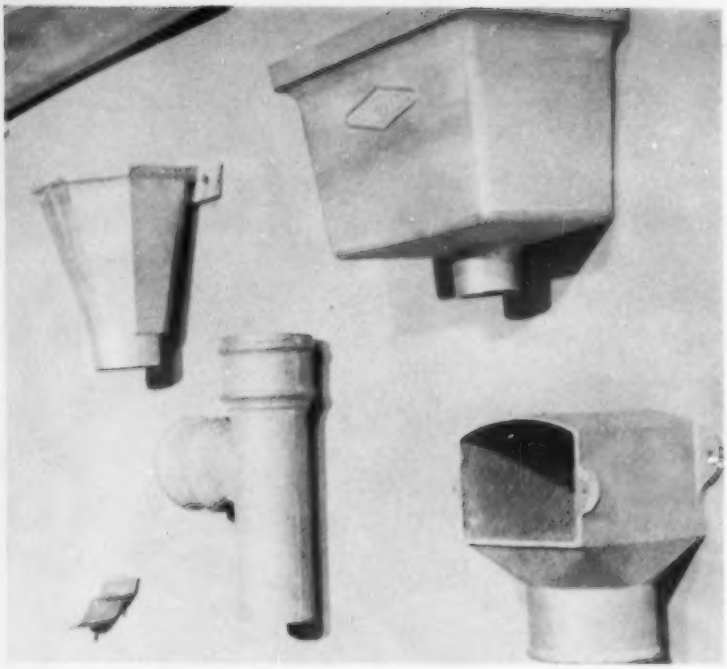


INTERNATIONAL BUSINESS MACHINES CORP.
General Business Machines

The group of 13 parts illustrated represent only a small portion of the different parts made by powder metallurgy for I.B.M. Some of the parts are made by outside vendors and some by an inplant department.

Part Name	Material	Function	Old Process
1. Pillow Block	Bronze	Acts as a bearing and support for shaft operating various mechanisms.	Machined
2. Cam-Hinge	Iron-Copper	Common link for hinge between stationary and movable control panels frame acts as pivot point for dash pot.	Blanked-Machined
3. Bearing	Bronze	Bearings used to mount shafts that carry the circuit breaker cams.	Sintered Metal
4. Slug-Magnet	High Density Copper	Used on relay coil to reduce chatter or hum —parts are pressed on knurled core D. C. application.	Machined
5. 12-Lobe Cam	High Density Bronze	Operates circuit breakers.	Machined Steel
6. Cam	High Density Bronze	Operates a follower arm which advances the type wheels on clock recorder.	Machined, Two Parts Staked
7. Compound Gear Blank	High Density Bronze	Compound gearing for driving baffle stacker.	New Part
8. Hinge Cam	Iron-Copper	Cam action controls lacking of movable control panel in respect to preventing hanging motion in closing.	Blanked-Machined
9. Latch	Iron-Copper	Holds secondary brush unit—weight of latch holds brush unit from the contact during adjustments.	Machined
10. Cam Card Aligner	High Density Iron	Cam drives the paddle on the baffle stacker.	New Part
11. Shading Coil	High Density Copper	Used on relay coil to reduce hum—parts are staked to core—A. C. application.	Machined
12. Slug Print Wire	High Density Brass	Acts as guide and inertia member in high speed print unit.	New
13. Ratchet	High Density Brass	Drives gear that controls the clock hand from the type wheel. Meshes with a straight tooth gear.	Machined, Two Parts





Several aluminum alloys are used to get the range of properties and surface quality needed for use in buildings.

British builders are now using

Large Aluminum Castings For Rain Water And Fire Water

IN a recent British exhibit of aluminum used in modern buildings, several die and permanent mold castings were displayed which have no American counterparts, so far as is known.

Among the highlights of the show, sponsored jointly by the Aluminium Development Association and the Building Centre, were several items of "rainwater goods" and some large elements of fire fighting equipment, all produced by die casting or permanent mold casting (called pressure die casting and gravity die casting in England).

The rainwater goods, above, consisted of several conductor fittings and one end cap, some die cast and some permanent mold cast. Alloy used for these pieces is LM2-M, which contains 9-11.5 percent silicon and 0.7-2.5 copper as principal alloy constituents.

The fire fighting equipment, left, are all gravity die castings in three alloys. The delivery hose coupling, branchpipe and caps are cast in alloy LM5, which contains 3-6 percent magnesium. The standpipe, nozzle, and body for the threeway head are all cast in LM8, which contains 3.5-6 percent magnesium. Other castings are in LM-10 which is a 9.5-11 percent silicon alloy.

For more information circle No. 4 on the Reader Service Card

dag 'dag' dispersions... *a touch does so much!*

Outer housing and other pieces of the die are dipped into **'Aquadag'**.

Outer housing of die with finished casting ready for removal. Press will force casting from mold.

Castings after removal from mold.

'Aquadag' Succeeds Where Others Fail...

Reports Diehl Manufacturing Company

When molten aluminum at 1300-1400 degrees F. is poured into a centrifugal mold spinning at high speed, an exceptionally durable parting compound must be used. **'Aquadag'** has been satisfying this need for 14 years in a centrifugal casting operation at Diehl Manufacturing Company, Electrical Division of the Singer Manufacturing Company, world-renowned makers of Singer Sewing Machines. Other products have been tried, but without success.

Diehl reports that **'Aquadag'** pays off in three ways:

By speeding production
By increasing mold life
By producing better castings

'Aquadag' protects the mold against the impact of high-velocity molten aluminum. It prevents aluminum from adhering to the die, and protects the purity of the castings by preventing iron transfer from the mold to the aluminum melt. One application of **'Aquadag'** lasts for at least six castings, which are produced at the rate of about one per minute per machine.

Write for Acheson Bulletin 425 on Metal Casting Operations for practical information on product improvement and lower costs in your own shop. The Acheson Service Engineer in your area will be glad to consult with you.

For ready-to-use materials containing 'dag' dispersions see your own oil supplier, or write directly to us.

100th Anniversary

1851—SILICON CARBIDE
1896—SYNTHETIC GRAPHITE
1906—COLLOIDAL GRAPHITE

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Port Huron, Michigan, Dept. I-10

Yes, I want your free bulletin describing **'dag'** Dispersions for Metal Casting Operations.

Name_____

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City_____ Zone____ State_____

Investment Casting Institute November Meeting Features Symposium on Vacuum Metals

Members of the Investment Casting Institute will meet in Detroit on Nov. 13, 14, and 15 for their annual meeting. The Board of Directors and I.C.I. committees will hold separate meetings Tuesday, Nov. 13, and the regular business session, reception, and banquet will take place Wednesday, Nov. 14. Headlining the business session will be a panel analysis of "Costing Problems in the Investment Casting Industry."

On Thursday, Nov. 15, the technical session will be held which features a demonstration and discussion on the Glasscast process by Dr. N. J. Grant, an I.C.I. consultant from Massachusetts Institute of Technology.

Thursday's agenda also includes a paper on "The Relationship Between Liquid Metals and Ceramic Mold Surfaces" by Dr. Howard Taylor of M.I.T.; a discussion of the "Use, Applications, and Problems of Soluable Cores" by C. W. Schwartz, Misco Precision Casting Co.; and a panel discussion on "Techniques and Controls for Investing and Precoating."

In conjunction with the regular three day program, the Institute has scheduled a special Vacuum Metals Symposium to be held Friday, Nov. 16, under the chairmanship of Dr. Jack Keverian of General Electric Co. Subjects on the program are:

"Vacuum Melting — Past and Future"
Dr. N. J. Grant, M.I.T.

"Influence of Vacuum Melting on Properties of Various Materials"
Dr. R. K. McKechnie, research laboratory, General Electric Co.

"Comparison of Various Vacuum Equipment and Operational Technology"
J. H. Moore, manager, Vacuum Metals Corp.

"The Use of Molding Materials and Refractories for Vacuum Casting"
H. O. MacIntyre, Battelle Memorial Institute

"Economics of Vacuum Melting and Casting"
Dr. F. N. Darmara, v.p., Utica Drop Forge Co.

"Summary: The Case for Vacuum Melting"
Dr. Howard Taylor, M.I.T.

According to V. S. Lazzara, I.C.I. president, the symposium will be open to all companies and all individuals who are interested in the particular topic.

BASSICK NAMES AGENT

The Bassick Co., Bridgeport, Conn., has appointed The Metallurgical Products Co., Brookline, Mass., as sales agent to handle the Bassick line of sintered metal parts for New England and eastern New York state.

YESTERDAY
TOMORROW
The Trend is with Badger...
BADGER quality makes your product more competitive!
• Zinc and Aluminum Die Castings •
BADGER
DIE CASTING CORP.
281 WEST OKLAHOMA AVE. MILWAUKEE 7, WISCONSIN
For more information circle No. 14 on the Reader Service Card

DUAL FUNCTION is served by inserting a spring-type clip in the cored rectangular hole (arrow) in the base casting. This not only holds the pivot pin on which the tilting member of the microscope rides, but also acts as a spring washer to hold the unit in position by friction. All three of the main structural components are zinc die castings.

ALL PHASES of manufacturing are keyed to low cost: forming, finishing and assembling. Few machining or hand fitting operations are required.

As this manufacturer of toys found

Even A Low-Cost Product Can Be Precision Built

MODERN educational trends dictate that amusement devices for children must also be educational. Therefore, if a junior microscope is to be successfully marketed it must be able to give the young scientist a clear, undistorted image.

It follows then that the optics must be of glass, ground with reasonable precision; the alignment of eyepiece and objectives must hold when objectives are changed; and alignment of the optical system with the stage must be held constant so that focusing can be done without either distortion of a part of the object or without losing the field of examination due to lateral movement during focusing. And all of these requirements . . . as well as some others to be mentioned later . . . must be met sufficiently economically so that the finished instrument can be sold for less than $10 at retail levels.

Depending upon the ultimate magnification desired and the degree of flatness of field and color correction desired, the optical system becomes rather rigidly fixed. Such manufacturing economies as are possible must then come in the forming, finishing and assembly of the metal components of the instrument.

The best and most obvious starting point for low cost production is to fabricate as many parts as possible by die casting in zinc, aluminum or magnesium. The designer must, therefore, fit as many of the components as possible within the frame-work of what can be cast by this process. In the case of a microscope, the instrument can be broken down into three major parts — the base, the tilting sup-

Continued next page

Now 2 HOUGHTO-SAFE Hydraulic Fluids

to give you

Two Fire-Safe Hydraulic Fluids to provide maximum operating efficiency and eliminate danger of Hydraulic Fires

Up to eighty-five percent of all hydraulic applications can operate at top efficiency . . . with complete protection from fire danger . . . with Houghton's Houghto-Safe 620. Houghto-Safe 620 is a water-base fluid which will not burn nor explode. Packings don't have to be changed when you install it. It is non-toxic, safe to handle. It guards against rust and corrosion. Plus benefit: Houghto-Safe 620 costs less than other types of fire-resistant hydraulic fluids.

For systems running consistently above 150°F. and for heavily loaded pumps and bearings, you can get peak hydraulic efficiency with Houghto-Safe 1020. This is a new, specially compounded and fortified synthetic fluid—a further exclusive development of Houghton Research that serves to prevent rust, resist foaming and increase the oiliness factor, thus reducing wear.

Ask your Houghton Man about the two types of Houghto-Safe. He'll be glad to show you how they can take fire danger out of *any* hydraulic job in your plant. E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

HOUGHTO-SAFE . . . product of . . .

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PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

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port and the tube to carry the optics. All three of these parts can be die cast in aluminum in almost finished condition.

Considering each of the three major castings, the first is the base. This casting has been so designed that the only finishing operation necessary is to drill one hole to clear the pivot pin which is a simple machine screw. Since the tilting frame member must ride on this screw freely, but remain in a fixed position to fit the comfort of the operator, some spring loading device must be incorporated. It is further necessary to use either a nut or a threaded portion in the casting to hold the pivot pin in place. By casting the rectangular slot that is apparent in the illustration a Speed-Nut can be used as both a fastener and a spring washer to give the necessary friction between the two moving members so that the tube can be set at any angle of inclination desired. The use of this sort of fastening device eliminates machining and assembly operations and gives a better end product.

The tilting frame member is also die cast to final condition except for drilling the two small holes into which the slide holding clips fit. On this casting, the alignment of the instrument may depend. Standard construction of microscopes is to use a dovetail way which fits a dovetail groove in the optic tube. This same type of construction is followed in this instrument.

While the degree of precision is, of course, not as great as found on hand fitted microscopes the die casting process is sufficiently accurate to cast this dovetail to size and shape without requiring any secondary machining.

Here it should be noted that the critical dimensions and surfaces are held within the die blocks and the parting line of the dies so located that any residual flash, after trimming, will come where there is adequate clearance thus eliminating a surfacing operation that might otherwise be necessary.

The third major part is the optical tube casting. On this casting the greatest accuracy of any part is required. Since this instrument is provided with two eyepieces and a revolving turret with

Continued on page 64

Brought together here for the first time are some of the more commonly used metals and alloys that can be cast by one of the PMM casting processes. Intended as a working guide to tell you what's available to meet your design needs, it reveals an enormous range of properties that are available to you. Accuracy, of course, is an inherent advantage when you cast these alloys by the processes indicated.

Take Your Pick Of Alloys That Can Be Cast By PMM Processes

IF you need special properties in some component you are designing, the odds are that you can find what you need in the enormous range of alloys that can be cast by one or another of the precision metal molding processes.

Whether you are looking for high tensile strength, good electrical conductivity, ductility or some other service characteristic, you'll probably be able to meet your specs and, at the same time, get the inherent accuracy found in the several PMM processes.

Listed on the next eight pages are typical compositions and properties and while the list is far from a complete tabulation of all alloys, it is representative. Powder metallurgy has been omitted from this listing, since range of materials and properties may differ considerably from those of the cast alloys. If any of the materials listed look promising, your metals supplier or castings vendor can advise you specifically concerning the use of these materials in your products.

This chart enables you to work backward from the properties you are seeking, to find first the alloy that gives those properties, and then, the casting processes by which that alloy is formed.

Note that values listed in the tabulation are median values; no high and low limits are shown for reasons of space and legibility. More detailed analyses are available, where needed. Also, where several sources show variations in composition or properties, a typical value has been chosen.

With regard to investment casting, it should be pointed out that almost any castable alloy can be cast by this process. However, the only alloys that have been marked as "investment casting alloys" are those specifically indicated as such in the source literature. The actual range of composition of these materials is almost limitless.

Alloys are typical of those in current production, but not all casters necessarily cast all alloys. Only direct inquiry can determine this. Physical properties are subject to variations in actual castings due to differences in casting technique, cooling rate, configuration of castings, and other such factors.

Sources from which the data have been obtained include: "Metal Data" by S. L. Hoyt; "Alloy Digest" by Engineering Alloys Digest, Inc.; American Society for Testing Materials, 1955 Standards; American Die Casting Institute, Investment Casting Institute.

COMPOSITION AND PROPERTIES ARE LISTED ON THE FOLLOWING PAGES . . .

52 Aluminum
54 Copper
56 Magnesium
56 Lead & Tin
56 Zinc
56 Cobalt
56 Iron
58 Nickel

TYPICAL ALLOY RANGE FOR T

COMPOSITION

ALLOY		ALUMINUM	BERYLLIUM	COBALT	CHROMIUM	COPPER	IRON	MAGNESIUM	MANGANESE	NICKEL	PHOSPHORUS	LEAD	SILICON	TIN	TITANIUM	ZINC	OTHERS
COMMERCIAL	ASTM																
ALUMINUM BASE:																	
13	S12B	Bal.				0.6	2.0	0.10	0.35	0.50			12.0	0.15		0.50	0.25 total
380	SC84B	Bal.				3.5	2.0	0.10	0.50	0.50			8.5	0.35		1.0	0.50 total
360	SG100B	Bal.				0.6	2.0	0.50	0.35	0.50			9.5	0.15		0.50	0.25 total
39-11	SC114A	Bal.				3.75	1.3	0.10	0.050	0.50			11.25	0.35		1.0	0.50 total
218	G8A	Bal.				0.25	1.8	8.5	0.35	0.15			0.35	0.15		0.15	0.25 total
43	S5C	Bal.				0.80	2.0	0.10	0.35	0.50			5.25	0.15		0.50	0.25 total
85	SC2	Bal.				3.5	2.0	0.10	0.50	0.50			5.0			1.0	0.50 total
384		Bal.				3.4							12.0		(nominal)		
A 108	SC64A	Bal.				4.5	1.0	0.10	0.50				5.5		0.20	1.0	0.50 total
113		Bal.				7.0	1.4	0.07	0.50	0.30			2.0		0.20	2.2	0.50 total
C 113	CS72A	Bal.				7.0	1.4	0.07	0.50	0.30			2.5		0.20	2.5	0.50 total
122	CG100A	Bal.				10.0	1.5	0.25	0.50	0.30			2.0		0.20	0.50	0.30 total
A 132	SN122A	Bal.				1.0	1.3	1.0	0.10	2.50			12.0		0.20	0.10	0.05 ea.
D 132		Bal.				3.0	1.2	1.0	0.50	1.00			9.5		0.20	0.50	0.5 total
138	CS104A	Bal.				10.0	1.5	1.0	0.50	1.00			4.0		0.20	0.50	0.5 total
142	CN42A	Bal.			0.2 max	4.0	1.0	1.5	0.30	2.00			0.7		0.20	0.30	0.15 total
152	CS66A	Bal.				6.5	1.5	0.4	0.80				5.5		0.20	0.80	0.8 total
B 195	CS42A	Bal.				4.5	1.2	0.05	0.3	0.3			2.5		0.20	0.30	0.3 total
A 214	GZ42A	Bal.				0.3	0.6	4.0	0.8				0.3		0.20	1.80	0.05 ea.
319	SC64C	Bal.				3.75	1.2	0.5	0.8	0.5			6.25		0.20	1.00	0.5 total
333		Bal.				3.75	1.2	0.6	0.8	0.5			9.0		0.20	1.00	0.5 total
355	SC51A	Bal.				1.25	0.8	0.5	0.5				5.0		0.20	0.30	0.15 total
IC 20356	SG70A	Bal.				max 0.2	max 0.6	0.3	max 0.3				7.0		max 0.20	max 0.30	0.15 total
C 612		Bal.				0.50	1.4	0.35	0.05				0.30		0.20	8.50	0.15 total
750		Bal.				1.0	0.7		0.1	1.0			0.7	6.25	0.20		0.30 total
	SC64B	Bal.				3.8	1.0	0.1	0.5	0.3			6.25		0.20	1.0	0.5 total
IC 20355		Bal.				1.25	0.6	0.5	max 0.3				5.0			max 0.2	Cr & Ti 0.19 total
40		Bal.				0.8		0.4								8.0	
60		Bal.				1.3		0.5	5.0								

Note: Where the original composition or properties of the above alloys include an upper and lower limit, only a median value is shown here.

THE PMM CASTING PROCESSES

PROPERTIES

ULTIMATE TENS. STR. PSI	YIELD STR. PSI 0.2% o.s.	ELONGATION % in 2"	HARDNESS AS CAST BRIN.	ELEC. COND. % IACS	THERM COND. BTU/ft²/hr/in./°F	THERM EXPANS in/in/°F x10⁻⁶	DENSITY gm/cc	SPEC GR lb/cu in	ENDUR LIMIT PSI — @ 50 x 10⁶ cyc.	SHEAR STR PSI	MOD OF ELAST x 10⁶	CASTABLE FORM*	ALLOY
36,000	21,000	2.0		31	0.29	11.9	2.65	0.096		25,000		D,P	13
43,000	25,000	2.0		23	0.23	12.1	2.71	0.098		28,000		D	380
43,000	25,000	3.0		29	0.27	12.2	2.63	0.095		27,000		D	360
43,000	27,000	2.0		23	0.23	11.7	2.70	0.098		28,000		D	39-11
41,000	27,000	7.5		24	0.23	13.9	2.57	0.093	23,000	28,000	10.3	D	218
30,000	16,000	5.0		37	0.34	12.9	2.65	0.096	17,000	19,000	10.3	S,P1 D,P,I	43
40,000	24,000	5.0		28	0.27	12.6	2.79	0.101	22,000	26,000		D	85
46,000	27,000	1.0		23	0.23	11.7	2.70	0.098	21,000	29,000		D	384
28,000	16,000	2.0		37	0.34	12.5	2.79	0.101		22,000		P,I,S	A108
28,000	19,000	2.0		30	0.28	12.8	2.92	0.106		22,000		P,S	113
30,000	24,000	1.0		27	0.26	12.7	2.92	0.106	9,500	24,000		P,S	C113
35,000	31,000	1.0		34	0.32	12.6	2.95	0.107		25,000		P,S	122
36,000	28,000	0.5		29	0.29	11.3	2.72	0.098	13,500	28,000		P	A132
36,000	28,000	1.0		26	0.26	11.9	2.76	0.100	13,500	28,000		P	D132
30,000	24,000	1.5		25	0.25	12.5	2.95	0.107		24,000		P	138
40,000	34,000	1.0		34	0.32	13.0	2.81	0.102	10,500	30,000		P,S	142
												P	152
37,000	19,000	9.0		33	0.32	12.7	2.80	0.101	9,500	30,000		P,I,S,P1	B195
27,000	16,000	7.0		34	0.32	13.8	2.68	0.097		22,000		P,S,P1	A214
34,000	19,000	2.5		27	0.27		2.74	0.099		24,000		P,S	318
34,000	19,000	2.0		26	0.25	12.0	2.77	0.100	14,500	27,000		P	333
30,000	24,000	2.0		39	0.36	12.9	2.71	0.098		24,000		P,I,S,P1	355
40,000	27,000	5.0		41	0.38	12.7	2.68	0.097	13,000	32,000		P,I,S	IC20356
35,000	18,000	8.0		40	0.38	13.6	2.84	0.103				P	C612
20,000	8,500	10.0		46	0.43	13.5	2.87	0.104	9,000	13,000		P	750
25,000	20,000	2.0										P,S	SC64B (ASTM)
												I	IC20355
26,300	19,500	6.0		27		13.6	2.77	0.100			10.3	P1	40
16,500	15,000	1.0										P1	60

*KEY: D—die casting; I—investment casting; P—permanent mold casting; P1—plaster mold casting; S—shell mold casting.

COMPOSITION

ALLOY COMMERCIAL ASTM	ALUMINUM	BERYLLIUM	COBALT	CHROMIUM	COPPER	IRON	MAGNESIUM	MANGANESE	NICKEL	PHOSPHORUS	LEAD	SILICON	TIN	TITANIUM	ZINC	OTHERS
ALUMINUM BASE—continued																
GS42A	Bal.			0.25	0.35	0.8	4.0	0.8				1.8		0.25	0.35	0.5 ea.
S5A	Bal.				0.15	0.8	0.05	0.35				5.25		0.25	0.35	0.05 ea.
S5B	Bal.			0.25	0.8	0.8	0.05	0.5				5.5		0.25	0.5	0.35 total
ZC60A	Bal.				0.50	1.4	0.35	0.05				0.35		0.25	6.5	0.15 total
ZC81B	Bal.			0.35	0.80	1.3	0.35	0.8	0.15			0.35		0.25	7.5	0.25 total
ZG32A	Bal.			0.30	0.2	0.8	1.8	0.5				0.2		0.25	3.0	0.05 ea.
ZG42A	Bal.			0.30	0.2	0.8	2.1	0.5				0.2		0.25	4.25	0.05 ea.
COPPER BASE:																
Z30A	.25 max				57.0 min	.25 max		0.25 max			1.5 max	0.25 max	1.5 max		30.0 min	.50 total
ZS331A	.15 max				65.0	.15 max		.15 max			.25 max	1.0	.25 max		Bal	0.50 total
ZS144A	.15 max				81.5	.15 max	.01 max	.15 max			.15 max	4.0	.25 max		Bal	.25 total
Yellow Brass					62.0						1.0		0.5		Bal	
Redaloy					53.0	1.0							0.5		Bal	
Tombasil					81.0							4.0			Bal	
Nickel Silver					46.0	1.5			16.0		1.5				Bal	
Silicon brass					64.5						.50 max	1.0			Bal	
Aluminum bronze B148-49 9A	10.0				88.0	2.0										
Aluminum bronze B148-42T	9.8				89.0	1.0										.5 total
Aluminum bronze	10.5				88.5	1.0										.5 total
Aluminum bronze B148-52 9B	10.5				87.5	1.25										
Aluminum bronze	11.0				Bal	3.75										.5 total
Aluminum bronze	10.5				Bal	4.5			5.0							.5 total
Aluminum bronze	14.0				Bal	4.75										.5 total
Aluminum bronze	15.0				Bal	5.0										Special
Aluminum bronze B148-49-9D	10.5				82.0	3.5			4.0							
Aluminum bronze B148-42T 9A-2	10.5				80.5	4.25			4.75							.5 total
Aluminum bronze	12.0				76.0	5.0			7.0							.5 total
Manganese Bronze B147-49	1.5				57.0	2.0		1.0							39.5	
Yellow Brass	0.5				59.5										40.0	
Silicon Bronze					81.5							5.0			14.0	.3 total

Note: Where the original composition or properties of the above alloys include an upper and lower limit, only a median value is shown here.

PROPERTIES

ULTIMATE TENS. STR. PSI	YIELD STR. PSI 0.2% o.s.	ELONGATION % in 2"	HARDNESS AS CAST BRIN.	ELEC. COND. % IACS	THERM. COND. BTU/ft²/hr/in./°F	THERM EXPANS in/in/°F x10⁻⁶	DENSITY gm/cc	SPEC GR lb/cu in	ENDUR LIMIT PSI — @ 50 x 10⁶ cyc.	SHEAR STR PSI	MOD OF ELAST x 10⁶	CASTABLE FORM*	ALLOY
19,000		1.5										P	GS42A
21,000	6,000	2.5										P,S	S5A
21,000	7,000	2.0										P,S	S5B
28,000	18,000	7.0										P	ZC80A
32,000	22,000	4.0										P	ZC81B
37,000	17,000	10.0										P	ZG32A
42,000	25,000	4.0										P	ZG42A
60,000	40,000	15.0									15.0	D	Z80A
70,000	35,000	25.0									15.0	D	ZS331A
85,000	50,000	25.0									20.0	D	ZS144A
58,000	36,000	6.2	125				8.5					D	Yellow brass
												D	Redaloy
85,000	50,000	8.0	170				8.3					D	Tombasil
85,000	65,000	15.0	160				8.45					D	Nickel Silver
70,000	35,000	22.0	120				8.8					D,I	Silicon Brass
80,000	35,000	15.0	$85R_B$	12.5								P,S	Aluminum bronze
79,000	32,000	35.0	$70R_B$									P,S	Aluminum bronze
85,000	40,000	22.0	$77R_B$									P,S	Aluminum bronze
80,000	36,000	21.0	$80R_B$	12.0								P,S	Aluminum bronze
100,000	38,000	12.0	175									P,S	Aluminum bronze
110,000	55,000	8.0	230									P,S	Aluminum bronze
92,500	70,000	0.5	325									P,S	Aluminum bronze
88,000	65,000		375									P,S	Aluminum bronze
95,000	53,000	12.0	$90R_B$	15								P,S	Aluminum bronze
95,000	55,000	7.5	$91R_B$									P,S	Aluminum bronze
110,000	82,000	2.0	$105R_B$									P,S	Aluminum bronze
75,000	30,000	20.0	$60R_B$	22								P,S	Manganese Bronze
45,000	30,000	22.0	$60R_B$	30								P,S	Yellow Brass
65,000	27,000	17.0	$72R_B$								15.0	P,I,S	Silicon Bronze

*KEY: D—die casting; I—investment casting; P—permanent mold casting; Pl—plaster mold casting; S—shell mold casting.

COMPOSITION

ALLOY COMMERCIAL ASTM	ALUMINUM	BERYLLIUM	COBALT	CHROMIUM	COPPER	IRON	MAGNESIUM	MANGANESE	NICKEL	PHOSPHORUS	LEAD	SILICON	TIN	TITANIUM	ZINC	OTHERS
COPPER BASE:																
(Gunmetal) Leaded Red Brass					85.0						5.0		5.0		5.0	
Red Brass					80.0						10.0		10.0			
Beryllium Copper		2.0	.5		Bal											
Beryllium Copper		0.6	2.6		Bal											
MAGNESIUM BASE:																
AZ91B	9.0				max 0.3		Bal	min 0.13	max 0.3			max 0.5			0.7	0.3 Total
AM100A	10.0				max 0.10		Bal	min 0.10	max 0.01			max 0.3				0.3 Total
AZ92A	9.0				max 0.25		Bal	min 0.10	max 0.01			max 0.3			2.0	0.3 Total
LEAD & TIN BASE:																
CY44A	max 0.01				4.5	max 0.08					max 0.35		91.0		max 0.01	Sb. 4.5
YC135A	max 0.01				5.0	max 0.08					max 0.35		82.0		max 0.01	Sb. 13.0
PY1815A	max 0.01				2.0	max 0.08					18.0		65.0		max 0.01	Sb. 15.0
YT155A	max 0.01				max 0.5						80.0		5.0		max 0.01	Sb. 15.0
Y10A	max 0.01				max 0.5						90.0				max 0.01	Sb. 10.0
ZINC BASE:																
3 AG40A	4.1				max 0.1	max 0.75	0.4				max 0.005		max 0.002		Bal	max Cd. 0.004
5 AC41A	4.1				1.0	max 0.75	0.4				max 0.005		max 0.002		Bal	max Cd. 0.004
COBALT BASE:	CARBON	COBALT	CHROMIUM	IRON	MANGANESE	TUNGSTEN	NICKEL	TITANIUM	SILICON	IRON	Others
Rex. X-40 AMS5382	0.50	Bal	25.5	Low	0.50		10.5	7.5			
Rex. VT AMS5385	0.25	Bal	27.0	Low	0.50	5.5	2.50				
Rexalloy A	1.2	Bal	28.0	Low	0.70			4.5			
Stellite 21	0.3	Bal	27.0	max 2.0	max 1.0	5.5	2.5		max 1.0			max B. 0.007
Allegheny S-816	0.38	44.0	20.0	max 5.0	max 1.8	4.0	20.0	4.0	max 0.9			Cb + Ta 4.0
I.C.I. 13518	0.25	Bal	27.5	max 3.0		5.5	2.75	max 1.0	max 1.0	max 0.04	max 0.04	
I.C.I. 13530	0.5	Bal	25.5	max 2.0	max 1.0		10.5	7.5	max 1.0	max 0.04	max 0.04	
Haynes No. 25	0.10	Bal	20.0	max 3.0	1.5		10.0	15.0	max 1.0			
Haynes No. 31	0.5	Bal	25.5	max 2.0			10.5	7.5				
FERROUS BASE:												
1020	0.2			Bal	0.4							
1040	0.4			Bal	0.85				0.6	max 0.04	max 0.04	1.0 Total

Note: Where the original composition or properties of the above alloys include an upper and lower limit, only a median value is shown here.

PROPERTIES

ULTIMATE TENS. STR. PSI	YIELD STR. PSI 0.2% o.s.	ELONGATION % in 2"	HARDNESS AS CAST BRIN.	ELEC. COND. % IACS	THERM COND. BTU/ft²/hr/in./°F	THERM EXPANS in./in./°F x10⁻⁶	DENSITY gm/cc	SPEC GR lb/cu in	ENDUR LIMIT PSI — (@ 50 x 10⁷cyc.	SHEAR STR PSI	MOD OF ELAST x10⁶	CASTABLE FORM*	ALLOY
34,000	17,000	25.0	60	15		10.5		0.318			13.0	I	(Gunmetal) Leaded Red Brass
35,000	17,000	20.0	65			9.1		0.322			11.0	I	Red Brass
60,000	45,000	30.0	115	17	0.17	9.5	8.04	0.29			17.0	I	Beryllium Copper
42,000	22,000	27.0	75	24	0.27		8.60	0.310			16.0	I	Beryllium Copper
34,000	23,000	3.0		10	0.17	15.2	1.80	0.066	14,000	20,000		D	AZ91B(ASTM)
20,000	13,000	2.0	54	15		14.0	1.81	0.066	10,000	17,000		P.S	AM100A(ASTM)
20,000				15		14.0	1.82	0.066				P.S	AZ92A(ASTM)
												D.P	CY44A(ASTM)
												D.P	YC135A(ASTM)
												D.P	PY1815A(ASTM)
												D.P	YT155A(ASTM)
												D.P	Y10A(ASTM)
35,000		3.0	75		0.273	15.2	6.6	0.238				D	3
45,000		5.0	80		0.26	15.2	6.7	0.24				D	5
			[illegible]										
110,000	64,000	15.0	27_C									I	Rex. X-40
88,000	65,000	8.6	29_C									I	Rex. VT
118,000	87,000	0.5	42_C									I	Rexalloy A
103,000	82,000	8.0	65_A			7.83	8.3	0.299			16.8	I	Stellite 21
140,000	67,000	31.0				6.6	8.66	0.313			35.2	I	Allegheny S-816
52,000		10.0	34_C									I	I.C.I. 13518
50,000		10.0	34_C									I	I.C.I. 13530
155,000	72,000	60.0	95_B			7.6	9.15	0.333			35.0	I	Haynes No. 25
113,000	79,500	8.0	21_C			7.8	8.81				36.0	I	Haynes No. 31
64,000	39,000	24.8	70_B									I	1020
100,000	90,000	10.0										I	1040

*KEY: D—die casting; I—investment casting; P—permanent mold casting; PS—plaster mold casting; S—shell mold casting.

COMPOSITION

ALLOY COMMERCIAL ASTM	CARBON	COBALT	CHROMIUM	IRON	MANGANESE	MOLYBDENUM	NICKEL	TUNGSTEN	SILICON	PHOSPHORUS	SULPHUR	OTHERS
FERROUS BASE—continued												
1045	0.45			Bal	0.8							
4130 (Mod.)	0.3		1.0	Bal	1.0	0.1						
4140 (Mod.)	0.4		0.95	Bal	0.75	0.2						
4615	0.15			Bal	0.55	0.25	1.8					
4620	0.2			Bal	0.55	0.25	1.9					
8620	0.2		0.5	Bal	0.8	0.2	0.55					
A.I.S.I. 410	0.1		12.5	Bal	0.4							
A.I.S.I. 416	0.1		12.2	Bal	0.4						0.3	
A.I.S.I. 420	0.35		13.0	Bal	0.4							
A.I.S.I. 431	0.15		16.5	Bal	0.5		2.0					
A.I.S.I. 440C	1.0		17.0	Bal	0.4	0.5						
A.I.S.I. 302	0.1		18.0	Bal	1.5		9.0					
A.I.S.I. 303	0.1		18.0	Bal	1.5		9.0				0.3	
A.I.S.I. 304	0.07		19.0	Bal	1.0		9.0					
A.I.S.I. 316 AMS-5360	0.1		17.0	Bal	1.2	2.0	13.0					
A.I.S.I. 347 AMS-5362	0.08		19.0	Bal	1.2		12.0					Cb. 1.0
NICKEL BASE:												
I.C.I. 3200	max 0.15	max 2.5	16.5	5.25	max 1.0	17.0	Bal	4.5	max 1.0	max 0.4	max 0.3	V. 0.4
I.C.I. 3300	0.4	12.5	25.0	max 5.0	2.5	3.0	Bal	7.0	max 1.0	max 0.4	max 0.3	
Illium G	0.2		22.5	6.5	1.25	6.4	56.0		0.65			Cu. 6.5
Illium R	0.05		22.0	6.0	0.30	5.0	64.0		0.15			Cu. 2.5
Calite "N"	0.52		18.5	Bal	1.4		66.5		1.4			
Inconel	max 0.4		15.5	max 11.0	max 1.5		Bal		max 5.0			
Hastelloy "C"	max 0.15		16.5	5.75	max 1.0	17.0	Bal	4.5	max 1.0	max 0.04	max 0.03	V. 0.30
Monel	max 0.3			max 2.5	max 2.0		+ Co. 67		max 0.5			Cu. Bal.
Hastelloy "X"	max 0.2	1.5	21.75	18.5	max 1.0	9.0	Bal	0.8	max 1.0			

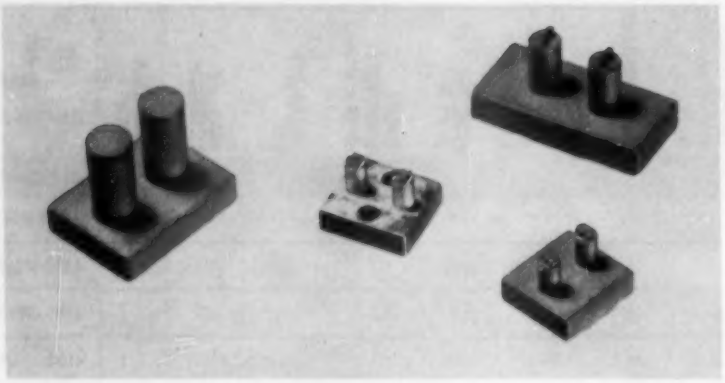
Note: Where the original composition or properties of the above alloys include an upper and lower limit, only a median value is shown here.

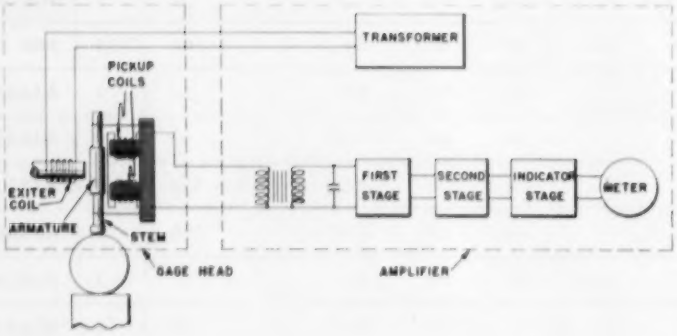
PROPERTIES

ULTIMATE TENS. STR. PSI	YIELD STR. PSI 0.2% o.s.	ELONGATION % in 2"	HARDNESS AS CAST BRIN.	ELEC. COND. % IACS	THERM COND. BTU/ft²/hr/in/°F	THERM EXPANS in/in/°F x10⁻⁶	DENSITY gm/cc	SPEC GR lb/cu in	ENDUR LIMIT PSI — @ 50 x 10⁷cyc.	SHEAR STR PSI	MOD OF ELAST x10⁶	CASTABLE FORM*	ALLOY
102,000	50,000	12.6	94_B									I	1045
100,000	79,000	17.3	95_B									I	4130 (Mod.)
115,000	89,000	17.5	22_C									I	4140 (Mod.)
												I	4615
84,000	64,000	15.3	92_B									I	4620
												I	8620
123,000	108,000	20.3	24_C									I	A.I.S.I. 410
125,000	113,000	11.4	25_C									I	A.I.S.I. 416
												I	A.I.S.I. 420
130,000	106,000	16.3	27_C									I	A.I.S.I. 431
												I	A.I.S.I. 440C
												I	A.I.S.I. 302
												I	A.I.S.I. 303
82,000	33,000	48.0	76_B									I	A.I.S.I. 304
73,000	32,000	52.0	73_B									I	A.I.S.I. 316
76,000	38,000	25.8	94_B									I	A.I.S.I. 347
			21_C									I	I.C.I. 3200
65,000		1.0	28_C									I	I.C.I. 3300
68,000	38,900	7.5	89_B		0.029	13.5	8.58	0.31				I	Illium G
122,800	50,200	15.7	85_B		0.029	13.5	8.58	0.31			27.5	I	Illium R
73,400	34,750	6.5	92_B	1.33		6.5	8.22				31.0	I	Calite "N"
82,500	37,500	20.0			0.036	6.4	8.43	0.307			31.0	I	Inconel
76,000	46,000	17.0	93_B	1.33	0.03	7.0	8.94	0.323			28.5	I	Hasteloy "C"
77,000	32,000	40.0	74_B			7.8	8.83	0.319				I	Monel
71,000	44,000	22.0				7.7	8.23	0.297				I	Hasteloy "X"

*KEY: D—die casting; I—investment casting; P—permanent mold casting; Pl—plaster mold casting; S—shell mold casting.

MAGNETIC PERMEABILITY IS CRITICAL . . .





HEAT TREATING has been eliminated by investment casting the pickup coil mounting plates, top left, used in the electronic gaging instruments, above, made by Cleveland Instrument.

. . . IN THE OPERATION OF THESE GAGES

THE investment cast mounting plate for the pickup coils in the gage head plays an important role in the operation of this instrument. Outline below of the function of various components in the gage head, indicates the importance of this component, both for its dimensional accuracy and its electrical reluctance. All Cleveland gage heads contain the following parts:

1. **AN EXCITER COIL.** This coil is energized by 6-volt 60-cycle alternating current supplied by the amplifier.
2. **TWO PICKUP COILS.** These coils are so connected that the voltages induced in them are 180° out of phase. The exciter coil and pickup coils are fixed in position.
3. **AN ARMATURE.** The armature is close to the pickup coils, and moves with the stem of the gage head.

The exciter coil sets up an alternating magnetic field in the armature; and this, in turn, induces a voltage in the pickup coils. The voltage from the pickup coils goes to the amplifier; and it indicates the position of the armature, as follows:

When the armature is in central or zero position with respect to the pickup coils, the voltages induced in the two pickup coils are equal. Since these induced voltages are 180° out of phase, the gage head then has an effective output of zero voltage; and the amplifier meter reads zero.

When the armature is not in zero position, one pickup coil has an increased voltage; the other pickup coil has a decreased voltage; and the voltage difference and polarity act through the amplifier to indicate the amount and direction of the deviation from zero position.

You Can Improve

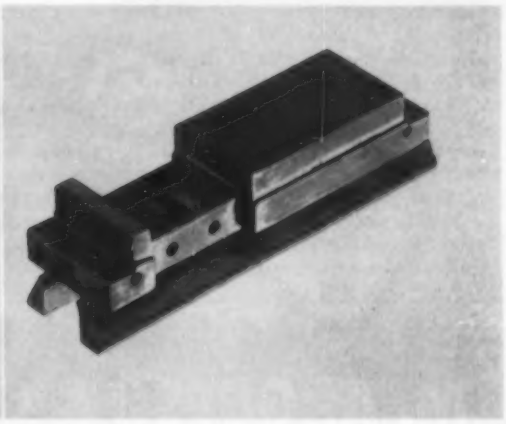
IT costs less nowadays to get the required precision in a metal component. Not that machining operations can be done for less money today, but by starting with a close-to-dimension investment casting all but finish machining can frequently be eliminated.

That is what Cleveland Instrument Company has found. This company, specializing in the design and manufacture of precision electronic gaging equipment, has used investment cast components for several years and is now studying a number of other components for possible conversion.

Cleveland Instrument's comparator-type electronic gages will measure deviations in dimension as small as .0000005 and thus, must be built with a very high degree of precision themselves.

Where the shape of a component lends itself (or can be adapted) to the investment casting process, the company has found it a good way to cut down on all

SIMPLE SHAPES that are now investment cast as a result of the company's first successful application of the process, include the case for their Par-Ac gage head, left, and the pivot arm for the Indi-Ac electronic indicator, center. They are cast in 1117 and 1020 steel, respectively.



COMPLEX SHAPES of investment castings include this newest piece, the slide which holds the pickup coil mounting plate. A great deal of heavy machining is eliminated, which is a distinct advantage for a company that is set up primarily for light bench assembly and light machining.

Electrical Properties With A Cast Structure

By **RICHARD E. ROGER,** Chief Engineer
Cleveland Instrument Co., Inc.

rough machining and hogging operations. They have also been able to improve performance in some instances.

Three different alloys are employed in the investment castings that go into Cleveland Instrument's gages. One of these is a special alloy having essential electrical properties. Castings are bought from three different commercial producers.

Improved electrical performance in a key component of the gage head has been achieved by switching from a three-piece assembly to an investment casting. The mounting plate that holds the two pickup coils is much more satisfactory in its present form than it was as a fabricated piece.

The critical part which this mounting plate plays in the operation of the gage head can be appreciated by examining the step-by-step description of its performance, left.

Because the sensitivity of the instrument depends upon the precise transmission of voltages from the two pickup coils, the electrical reluctance of the mounting plate is of critical importance. In the former type of construction, trouble was frequently encountered in getting consistent electrical transmission. The mounting unit was made by machining the two mounting pins from bar stock and pressing them into holes drilled in a piece of steel plate. The presence of air gaps between the posts and the plate increased the reluctance. This factor introduced a variable that was difficult to compensate for.

Now, the homogeneous structure of the casting relieves this condition. A 20 percent improvement in this condition has resulted. At the same time, due to the elimination of machining and assembly in a difficult-to-machine alloy, manufacturing cost has been cut by almost 60 percent on the smaller size units.

The alloy in which these mounting plates must be cast, 4750 steel, has been specified because of its electrical properties. Several years ago, an unsuccessful attempt was made to investment cast the mounting plates; although the investment caster was able to produce the desired shape within dimensional tolerances, the cast alloy did not have the electrical properties needed.

Now, the investment caster does not start with an alloy of the specified composition, but instead, has designed a composition which compensates for melting and casting losses. The result: a casting whose composition and properties meets all specifications.

The only machining requirement on the castings is to machine the gate from the base and then, locating from this surface, to grind the critical top surface of the two posts. In addition, holes

Continued next page

for mounting are drilled and tapped.

On the smaller size mounting plates, the narrow nibs at the top of the post (made narrower to increase the instrument's sensitivity) can be cast to size, but on the larger models, this feature must be milled. Center distances on posts is held to .003 by the caster.

The investment caster, Precision Metalsmiths, Inc., made polystyrene patterns of these components, some with and some without the small nibs at the top. It was found that on the trial runs, the nibs could be cast on the smaller posts, but had to be omitted from the larger ones. This "preview" of components makes possible the finalizing of designs before the pattern dies are made, thus saving possible costly alterations in the dies.

Further saving resulting from the use of investment castings here has been the elimination of heat treating. Previously, the mounting units were made from cold rolled stock which had to be heat treated in a closely controlled hydrogen atmosphere; now no heat treatment is needed.

As a result of their highly satisfactory experience, Cleveland Instrument has converted several additional components to investment castings.

Savings are the reason for making the pivot arm that holds the contact finger in the company's Indi-Ac gage head as an investment casting. Previous manufacturing methods had included a two-piece assembly and milling from the solid. Now, substantial savings have been realized by investment casting these tiny pieces, saving all operations except drilling, countersinking and facing.

The castings, made in 1020 steel by Midwest Precision Castings Co., are less expensive, sturdier and more dependable than the previous pieces.

Similarly the slide which holds the pickup pin mounting plate has been converted from a completely machined unit to an investment casting. This, the most recent of Cleveland Instruments' changes, is also cast in 1020 steel, by Alloy Precision Casting Co.

While this job is too new for any production experience, it is estimated that cost of this piece will be cut by about 20 percent which, in terms of dollars, is a substantial reduction. While almost every surface of the casting will still have to be finish machined, all roughing cuts and all hogging are eliminated. The very critical dovetail detail of the casting needs only a few thousandths of stock removal.

Here, for example, are the secondary operations to be performed, as contrasted with complete machining from the solid:

1. Sand bottom surface (no grinding needed).
2. Finish cut surfaces of dovetail.
3. Face across one end for over-all tolerance on length.
4. Grind gate from top surface.
5. Drill and tap.

As a general rule of thumb, Cleveland Instrument figures that any expenditure for tools should be amortized by savings on 500 to 1000 parts, although savings have been made, even on smaller annual quantities.

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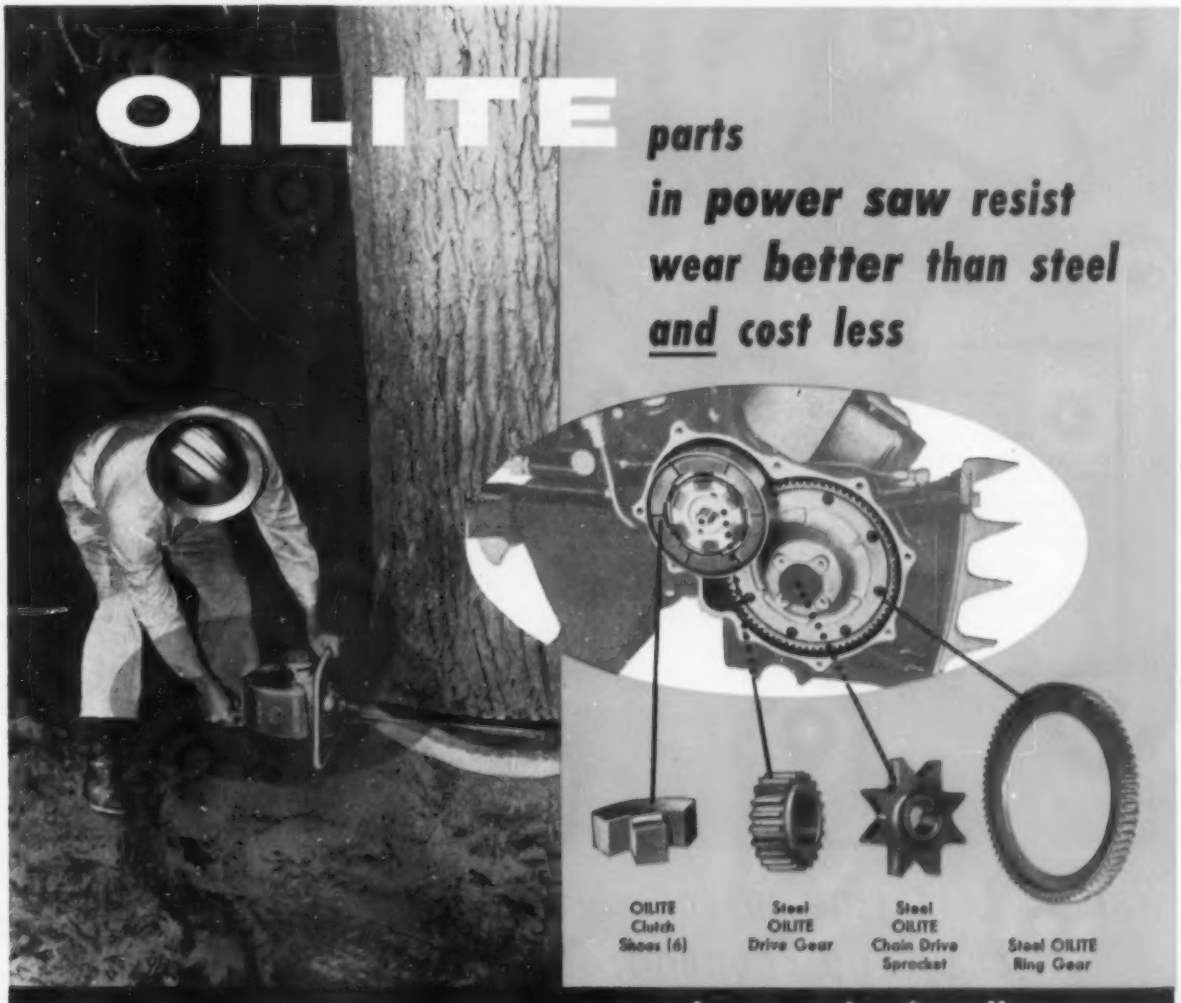
OILITE parts in power saw resist wear better than steel and cost less



Another cost-saving application of **Amplex Powder Metallurgy**

With a modern power saw—easy does it. It's easier on the inside, too, because this manufacturer has equipped vital components with extra tough, greater wear resistant OILITE precision parts. The manufacturer's report indicates that OILITE powder metal sprockets and gears offer *greater wear resistance than alloy steels.*

Furthermore, in using OILITE precision parts the manufacturer of the power saw realizes *substantial cost savings over parts fabricated by any other process.*

What this manufacturer is accomplishing with OILITE precision parts, you can too. Or, perhaps, in your case OILITE self-lubricating bearings and bearing materials can help you lick the problem of providing lubrication in hard-to-get-at places. In permanent metal filters, too, OILITE provides a wide choice of shapes, sizes and porosities to meet product requirements.

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New 52-page OILITE Engineering Manual. Supplies valuable engineering data and application information on OILITE powder metal bearings, parts and filters. Ask for Manual E-56. Write: Dept. N.

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1
2
3
Recessed lettering on this oven control (1) requires raised letters in the cavity. Yet, from one master hob (2), you get multiple molds or dies with raised lettering (3), in any quantity, with a minimum of machining, filing and polishing.

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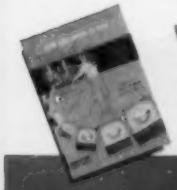
For lower tool costs and faster production . . . especially with multiple molds of complicated design . . . die hobbing is the method to choose. Because every cavity is cold pressed in steel from the same master, lettering and design details are always uniform. The high hobbing pressures (up to 100 tons per sq. in.) also cause the steel to flow and condense alternately, resulting in a closer surface grain structure. This provides an exceptionally long lasting luster . . . insures maximum fidelity of reproduction in the final product.



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MICROSCOPE

continued from page 50

three objectives, the tube must be so cast that proper optical alignment is maintained with any combination of lenses.

A further requirement of this casting is that means must be provided for vertical adjustment. Obviously, on a low priced microscope separately machined racks and pinions are not possible. To achieve the same effect, cross knurling is cast into the tube body as shown. On the tilting frame member a co-operating part is a pair of rubber grommets mounted on the shaft carrying the adjusting knobs. The distance between the shaft and the knurled faces is such that a friction drive results with the rubber acting as both a drive member and an elastic loading member to hold the optical tube in place when focus has been achieved.

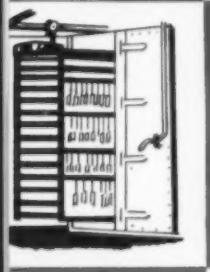
On the tube body, a dovetail slot is provided to fit the way on the tilting frame member. The elasticity of the drive grommets is sufficient to hold these two parts in proper lateral position.

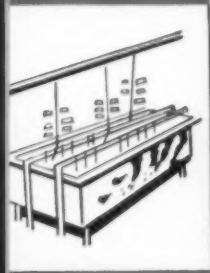
On the surface finishing of the microscope, the combination of excellent surface characteristic of the die casting process and the requirement that such an instrument have a non-reflecting surface make the choice of a wrinkle finish natural. With proper die maintenance and good trimming practice it is unnecessary to do any sanding, polishing, buffing or other smoothing operations. The parts are degreased, washed, dried and then given a single coating of either black or colored wrinkle finish paint.

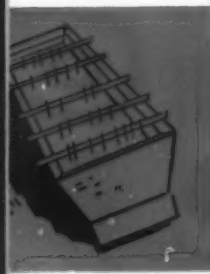
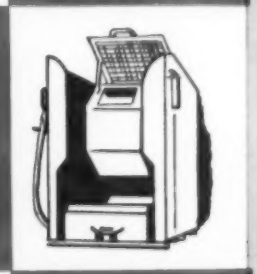
A.S.&R. TO EXPAND CONTINUOUS CASTING

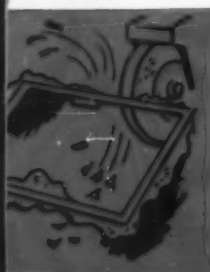
American Smelting and Refining Company will spend over $1,250,000 to expand its Perth Amboy, N. J. facilities for continuously casting bronze foundry alloys, it has been announced by J. D. MacKenzie, vice president in charge of operations.

The expansion program will begin this year and will increase the plant capacity by approximately 50 percent. Two new continuous casting furnaces will be installed in the enlarged plant structure.







PMM

Finishing Section

Finishing includes all secondary operations performed on precision metal molded parts — up to and including final surface treatment. This section presents new information about the specialized methods, equipment and materials needed for finish-machining, assembly, surface preparation and final finishing of all precision metal molded parts.

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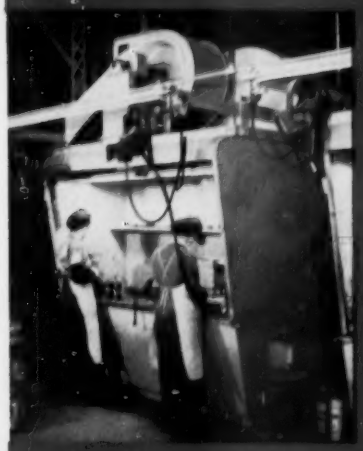

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For the proper and safest method of collecting highly inflammable dusts, fine chips and grindings, the Wet Method is BEST. Peters-Dalton Hydro-Whirl Wet Type Dust Collectors are efficient in operation . . . low in price . . . and provide maximum safety to plant and personnel, particularly during what can be hazardous operations, such as grinding, polishing and buffing magnesium alloys.

Illustrated here are four types of PD Wet Type installations. *Upper left*—well ventilated bench for the safe collection of dust produced from portable tool and flexible shaft grinding, polishing and buffing; *upper right* — dust collector for grinding stands and polishing jacks; *lower left* — water-wash type spray booth for removing noxious fumes created while spraying oxidation inhibitors containing fluorides or other toxic compounds on cores; *lower right* — high velocity side hood wet collector for dust, fumes and smoke during a foundry "shakeout" operation.

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When a protruding hub made it difficult to turn these pump housings on a lathe, the Graymills Corp. found that . . .

Belt Grinding Can Replace Machining Of Flat Surfaces

1. AUTOMATIC INFEED of Engelberg abrasive belt grinder carries the work against the belt until positive microstop is reached. Belt used for gray iron castings is 24-grit silicon carbide, wet.

FAST, accurate stock removal on component parts of immersion-type pumps is economically achieved at Graymills Corporation, Chicago, by use of a specially fixtured abrasive belt grinder, equipped with an air-oscillated automatic infeed table. A draw-bar air fixture, designed to handle several sizes of castings, permits short run flexibility and minimum setup time.

The pump's intake and discharge unit housing, or volute, consists of two parts, an upper and a lower half. The round castings, see Figure 2, extend out on one side to accommodate the discharge pipe. This protruding hub rendered the parts unsuitable for turning on a lathe or for surface milling, since the overhang caused deflection and distortion during machining. Resulting surface imperfections were revealed by Graymills' test inspections, where leakage was encountered in as much as 10 percent of pump production runs. Necessary remedial machining added to unit production costs.

Consequently, to increase unit production rates and insure surface uniformity, the Chicago firm installed a platen-type abrasive belt grinder. The machine, manufactured by Engelberg Huller Company, is equipped with an automatic infeed table. The table mechanism allows for a rapid approach to the grinding belt; the second, or machining, rate of feed is controlled by a hydraulic piston, and a positive micro-stop limits the amount of infeed travel.

The complicated shape of the volutes presented a fixturing problem, which was neatly solved by a draw-bar air device, Figure 2. The air fixture's shaft extends through an angle bracket and through the volute center. A C-washer locks the volute in position, and a pneumatic holding pressure of 100 pounds firmly anchors the casting during the grinding cycle.

A pneumatic table-oscillating attachment moves the volutes back and forth across the belt face. This oscillation, with stroke adjustment from ⅜ to 5½ inches, distributes belt wear evenly, facilitates belt flushing and rapid heat dispersion, and contributes to surface uniformity of the castings.

The legs of the volute castings are finished first, for general casting alignment, with 1/32-inch stock removal. The part is then

Continued next page

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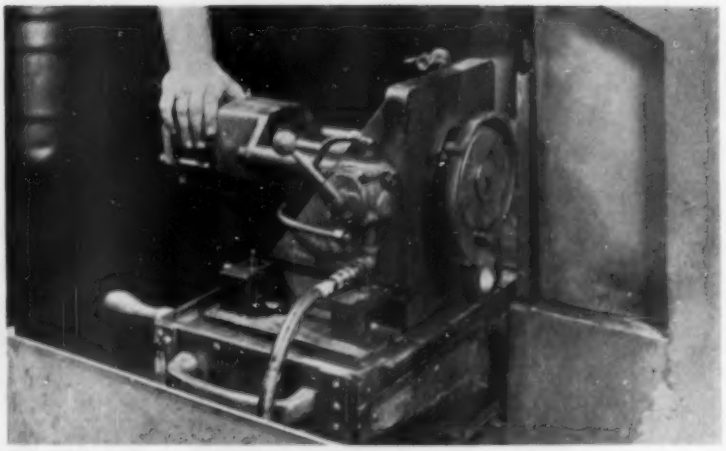
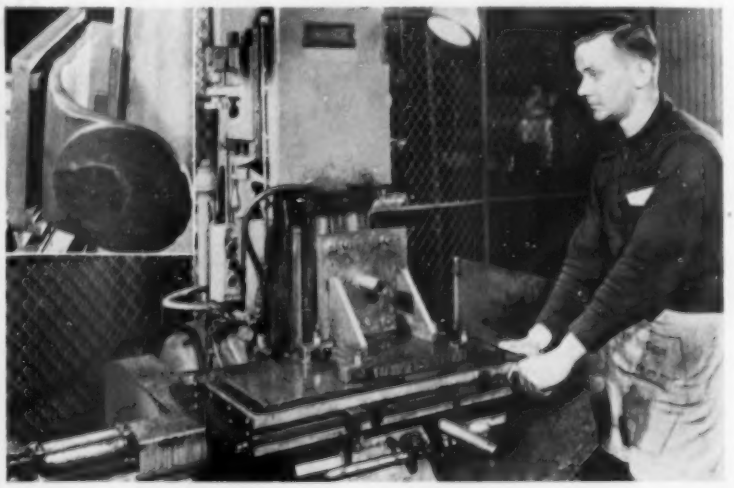


2. PUMP VOLUTE is firmly clamped to angle bracket by means of draw-bar air fixture. Single fixture accommodates four sizes of volutes. Stock removal is 1/32 inch.



3. SIMPLE ANGLE FIXTURE holds pump motor bracket during grinding of ribs. Pneumatic oscillating attachment, left, moves castings back and forth across belt face to insure even wear distribution.

BELT GRINDING—continued

reversed and the sealing, or mating, surface is belt-ground, with stock removal as in first operation of 1/32-inch. The sealing surface must be sufficiently flat, when gasketed with liquid sealer, to contain the pumped fluid under pressure of 40 p.s.i.

Grinding rates on these gray iron castings, despite the 1/32-inch stock removal requirement, are considerably faster than alternative methods, and belt life is very satisfactory. Unit time for surfacing volute legs is one minute, with average belt life of 100 pieces; for surfacing volute faces, 1½ minutes, with belt life of 45 pieces. Since the draw-bar air fixture handles four different volute sizes, setup time is appreciably reduced over prior machining methods. In addition, the leakage rejects formerly encountered because of surface flaws, have been eliminated.

Wet belt used is 24-grit silicon carbide, 8" x 107", with belt speed at 5000 s.f.p.m. Coolant is a water soluble chemical.

Belt, coolant, and belt speed are

Continued on page 85

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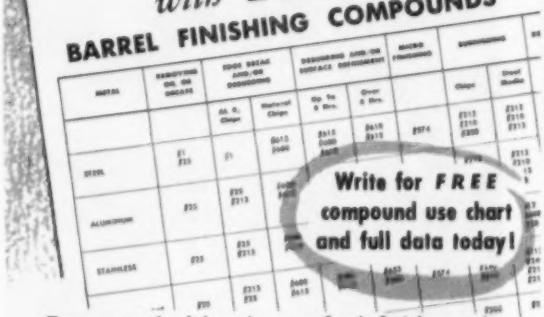

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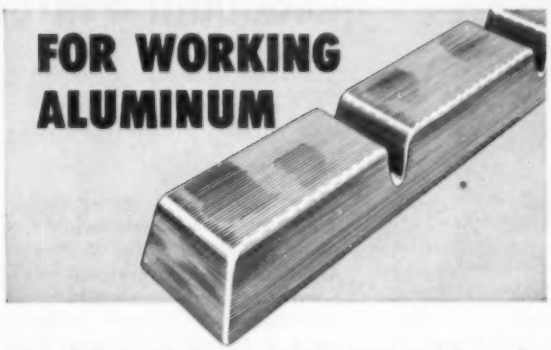

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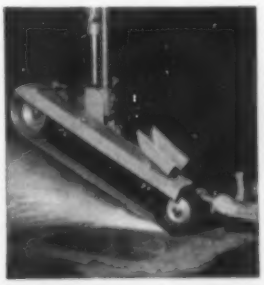
THE G & P 6-72 BELT UNIT



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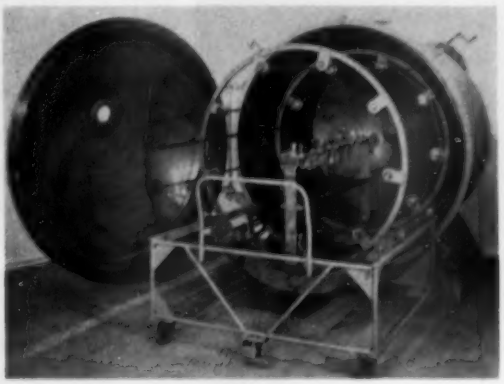
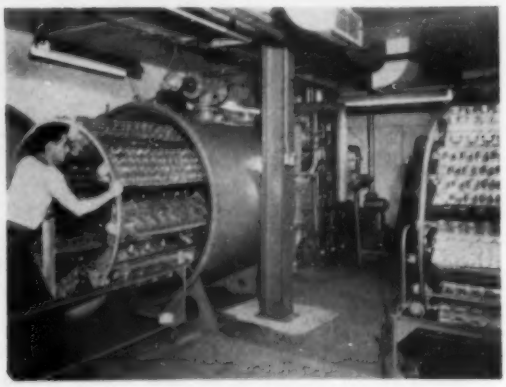
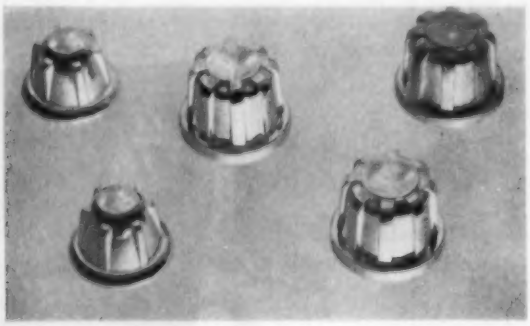
THIS IS THE TYPE OF INSTALLATION YOU MIGHT USE IF YOU WANT TO



RACK FOR METALLIZING accommodates many pieces. Work holders are mounted on each of the nine rods, with filaments and aluminum wire in the center.



INTO THE VACUUM CHAMBER goes the loaded rack of die castings. They will get a coating of aluminum between 1 and 1½ millionths of an inch in thickness.



This company has found that vacuum plating over zinc die castings is very economical: die cast radio bezels are plated for 3 cents apiece.

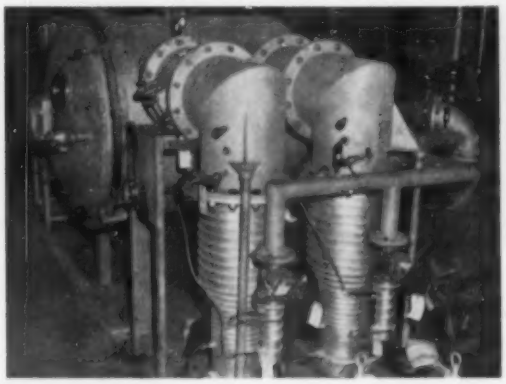
Vacuum Plating

BASED on a total operating cost of $30 per run, the Automatic Radio Mfg. Co., Inc. has found it most economical to convert from chromium plating by an outside job plater to in-plant vacuum plating on all parts that can be finished in this manner.

This economy is emphasized by comparing actual finishing costs on a typical piece. The front bezel of an automobile radio, for example, is a zinc die casting that, in the past, has been chromium plated, at a per piece cost of from 49¢ to 51¢. The identical part is now vacuum plated at a per piece cost of only 3¢. Where desired, the appearance is identical to chromium plating and both wear and corrosion resistance are reported to be equal.

The advantages gained through the use of vacuum coating are not limited to cost reduction. Inven-

DO YOUR OWN VACUUM PLATING



20-MINUTE CYCLE is an average, depending upon the number and shape of parts being coated. The actual metallizing takes less than a minute.

Photos: NARESCO Equipment Corp.

PROTECTIVE COATING is applied in this typical paint spraying setup. Almost any spraying system can be used, both for the undercoat and the top coat.

DIE CASTINGS

. . . $30 Per Load

tories of both finished and semi-finished parts can be drastically reduced, production scheduling is greatly simplified and special color finishes in a wide variety of colors that either could not be secured or secured only at considerable expense are now achieved at little or no additional cost.

To appreciate how these rather dramatic savings can be secured, it is necessary to first understand some of the basic principles of the vacuum plating process. Certain metals, aluminum is an outstanding example, have a very appreciable vapor pressure at or slightly above their melting points. Since these metals can be "boiled" readily, if the mean free path of the metal molecules can be greatly extended, it is then possible to surround the evaporating metal with a condensing surface and when the metal vapor strikes the cooler surface it will condense. It is thus theoretically possible, by proper control, to build up almost any desired thickness of aluminum, the theoretical minimum being a monomolecular layer.

For the purpose of vacuum plating, the metal molecules can be considered as moving in a straight line. Therefore, by the proper placement of the condensing surface and the evaporating metal, it is possible to completely coat any desired surface.

In this process the aluminum used is very high purity, 99.98 per cent metallic aluminum or higher, the heating elements for melting and evaporating the metal are tungston and the pressure in the evaporating chamber is reduced to 0.2 micron.

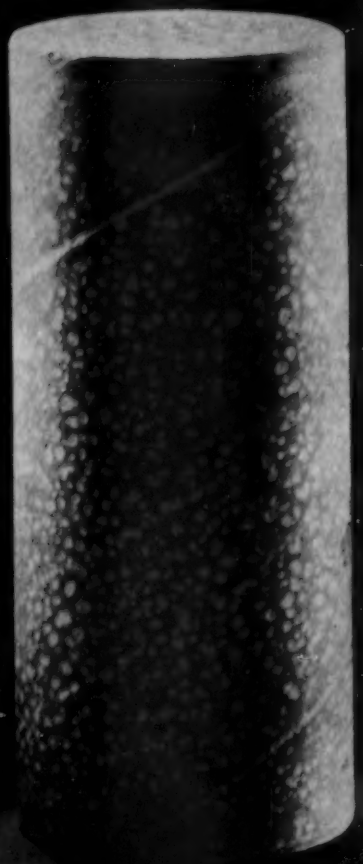
When the parts to be coated are relatively large and flat, they are generally racked around the inner surface of the vacuum chamber on stationary fixtures. In other cases, for example knobs and handles, the parts to be plated are placed on racks that can be rotated during the plating operation. In either case, both the parts and the aluminum to be evaporated must be so placed that every surface to be coated is exposed equally to the aluminum vapors.

Naturally, some preparation of the parts is required. In the case of die castings, a hardware finish is specified and the parts must be thoroughly washed and degreased.

Since some surface irregularities are bound to exist on even the best surface that can be cast, a clear synthetic coating is then applied by any convenient method. This coating serves to level out surface irregularities

Continued on page 73

STANDS ALONE



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and to furnish a good base for subsequent metal deposition. Of course, the synthetic coating must be dried and baked prior to metal deposition.

It should be noted that, in the pre-treatment of the castings, there was no polishing or buffing operation. Generally, if buffing is required, the cost of this operation is sufficient to destroy the economies of the vacuum plating process. *In other words, the major saving that is achieved through the use of this process is in the saving in surface preparation.*

After undercoating, the parts are put into the evaporator chamber and aluminum is deposited on the surface. At this stage, severe trouble can be encountered if the particular synthetic coating used for the undercoat is not completely stable or has too heavy an absorbed gas layer. Either of these conditions can result in an unduly long pumping time to reduce the evaporating chamber to the desired pressure.

With the equipment in use at Automatic Radio and the particular synthetic enamel that is used as an undercoat after baking the coated parts at 300 F for 30 minutes, the evaporation chamber can be reduced to a pressure of 0.2 microns in from 15 to 30 minutes, depending upon the parts making up the charge. After evacuation, actual metal deposition requires between 25 and 50 seconds, again depending upon the particular charge and the thickness of metal that is to be deposited. An average thickness for the aluminum deposited is between 1 and 1½ millionths of an inch.

Finally, after metal deposition, a protective coating of lacquer must be applied to prevent the destruction of the metal layer. Generally, the same type of synthetic is used for the overcoat as was used for the undercoat. In this case, a clear synthetic enamel and this second coating is baked for 30 minutes at 300 F. The surface thus formed is as durable and wear resistant as is generally found on any lacquered surface.

The last stage, the application of the overcoat, is where another of the advantages of this process becomes evident. If a clear lacquer is applied over the aluminum, the resulting finish is a silvery white mirror finish such as obtained with chromium plating. However, if it is desired to have a colored finish and still retain the mirror effect produced by the plating, the overcoat can be colored with any suitable clear dye. The resulting finish can, then, be any desired color.

SCHAFFNER ADDS SPACE

Schaffner Manufacturing Co., Inc., has begun construction on 15,000 sq. ft. of additional space at their Pittsburgh Metal Center to manufacture their new air-cooled, bias-type finishing buffs.

NAME CANADIAN REPS

Shell Process, Inc. manufacturer of shell molding and allied equipment, has appointed Edwin A. Swensson Co. as Canadian representative for western Ontario.

REM-CRU BUYS NEW SITE

Rem-Cru Titanium, Inc., jointly owned by Remington Arms Co., Inc. and Crucible Steel Co. of America, has purchased 262 acres of land in Industry Township, Beaver County, Pa. According to C. I. Bradford, president and general manager of Rem-Cru, the land is a tentative future site of a new research laboratory and administration offices.

The newly acquired property is located near the Ohio River about five miles northeast of the company's present production facilities in Midland, Pa.

"Tumblex* 'T' has a definite place in our tumbling department"...

That's the report from a leading pump manufacturer — when the new Norton bonded, triangular-shaped abrasive, gave results like these:

100% increase in barrel payload and 80% reduction in tumbling time. A sandblast operation eliminated and hand deburring reduced about 75%.

The uniform triangular shape and size of Tumblex "T" abrasive prevents wedging in recesses . . . Made of famous bonded ALUNDUM* abrasive, it cuts fast, with no cutting compound needed . . . It provides maximum surface contact with parts being processed, for shorter cycles and larger payloads . . . It wears evenly, and when worn down can be used on parts requiring a smaller abrasive . . . Its lightness means less weight required to fill the barrel.

Send your work samples to our Sample Processing Department. Let us prove how the latest barrel finishing equipment and techniques can add the "Touch of Gold" that improves your product quality and cuts finishing time and costs. NORTON COMPANY, Worcester 6, Mass. Distributors in all industrial areas, listed under "Grinding Wheels" in your phone book, yellow pages. Behr-Manning Company, Troy, N. Y., division of Norton Company. *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Mass.

G-316

NORTON
ABRASIVES
Making better products... to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories
BEHR-MANNING PRODUCTS: Coated Abrasives Sharpening Stones • Behr-cut Tapes

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

For more information circle No. 90 on the Reader Service Card

For more information circle No. 94 on the Reader Service Card

Facts to consider when you're buying

Chromate Conversion Coatings

for Corrosion Protection, Paint Base, Decorative Finishing

WHAT IS IRIDITE®?

Briefly, Iridite is the tradename for a specialized line of chromate conversion finishes. They are generally applied by dip, some by brush or spray, at or near room temperature, with automatic equipment or manual finishing facilities. During application, a chemical reaction occurs that produces a thin (.00002" max.) gel-like, complex chromate film of a nonporous nature on the surface of the metal. This film is an integral part of the metal itself, thus cannot flake, chip or peel. No special equipment, exhaust systems or specially trained personnel are required.

If your company is manufacturing or buying parts or complete assemblies made from or plated with any of the more common non-ferrous metals—zinc, cadmium, aluminum, magnesium, silver, copper, brass or bronze—you've probably already run up against the question of finishing these surfaces with a chromate conversion coating. These coatings are used to protect against corrosion, or to provide a base for paint or to provide a decorative finish for sales appeal or shelf life. Since chromate conversion coatings represent a relatively new means of obtaining these finishes, this digest of facts to consider may be of value to you.

1. THE COATINGS THEMSELVES. There are many brands on the market. All are similar in many ways. Each, of course, offers its own specific advantages and these may relate to operating techniques, performance under actual use conditions, cost, availability, etc. Naturally, you'll want to choose a coating that is widely known and accepted under both military and civilian specifications.

2. THE COMPANY BEHIND THE PRODUCT. Is it a reliable, established organization? Does it offer experienced technical service, both from the field-engineering organization as well as the home office and laboratories? The man who sells and services your installation should be thoroughly familiar with not only chromate conversion coatings and their applications, but also with the characteristics and performance of related finishing operations such as precleaning, electroplating, painting, etc. This is most important since all steps of the finishing cycle must be functioning properly for the satisfactory performance of the ultimate finish produced.

3. AVAILABILITY OF THE PRODUCT. Ideally, of course, the material should be readily available to you from nearby warehouses to avoid time loss in long distance shipping and to provide emergency service, should the need arise.

4. COST. Naturally, the initial price of the material is important to you. However, just as you consider ultimate cost when you are buying mechanical equipment, ultimate cost must be considered for these finishing chemicals. So, it will pay you to investigate consumption costs, labor costs and the other factors which go into the determination of ultimate cost. Further, cost alone gives no indication of product performance, so careful attention must be given to the purpose the finish must serve and the value that finish will add to your product.

5. FACILITIES FOR RESEARCH AND DEVELOPMENT. Perhaps the existing types of chromate conversion coatings do not include a compound that will accomplish exactly what you wish. Then, it is important to deal with a supplier who has adequate research and development facilities available to work with you to produce a material to meet your needs. Naturally, such a project is seldom completed overnight. But, with complete cooperation and confidence from both you and your supplier, chances are a satisfactory program can be completed.

These are the concepts of sales and service on which we, Allied Research Products, Incorporated, have developed and marketed the line of Iridite chromate conversion coatings . . . superior product performance, complete sales and technical service, easy product availability, economical cost, extensive research and development facilities. No doubt you are familiar with our line and have seen this trademark—

IRIDITE®

—in our advertising, technical literature or on shipping containers in your plant. Remember this trademark when you're buying or investigating chromate conversion coatings for your company. It's your assurance of quality, economical products from a reliable and established company, skilled sales and technical service from both our home office and a national network of representatives, immediate availability from warehouses in strategic industrial areas and our willingness to work with you to develop new finishes to meet your needs, should the present line fall short.

For complete information on Iridite chromate conversion coatings, write today for your free copy of our technical data file. Or, for immediate advice, call in your Allied Field Engineer. He's listed under "Plating Supplies" in your classified telephone book.

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD.

Manufacturers of Iridite chromate conversion coatings for corrosion resistance, paint systems, final finishing of non-ferrous metals; ARP Plating Brightener & Chemicals. West Coast Licensee—L. H. Butcher Co.

For more information circle No. 78 on the Reader Service Card

WORKING EXHIBIT, CLASSES AT METAL FINISHING SHOW

More than 35 manufacturers of metal finishing tools will exhibit their latest developments in the Metal Finishing Show Oct. 30-Nov. 2, in Cleveland. The working exhibit, sponsored by Behr-Manning Co., Troy, N. Y., a division of Norton Co., will take place at Behr-Manning's Cleveland branch at 4101 W. 150 St.

The event will give designers, production men, quality control men, and machine operators a chance to submit their problem components and products to actual grinding and polishing tests on all types of coated abrasive machine tools.

Machines to be demonstrated, many for the first time, will range from heavy grinders used in automobile and appliance production to belt machines for small-radius contours. Each day of the show, Behr-Manning product engineers will conduct classes on such subjects as choice of abrasives; performance comparisons of various belts; recommendations on belt speeds, grit sizes, coolants and lubricants; and demonstrations of abrasives on numerous metals.

NEW PLANT FOR PEERLESS

Peerless Gear & Machine Co., manufacturers of gears, speed reducers, and pinions and racks for die casting, have moved from Toledo to a plant at Dunkirk, Ohio. The new 16,000 sq. ft. building is said to afford 20 per cent more space and has enabled the company to consolidate operations formerly carried on at plants in Toledo and Trilby, Ohio.

According to George Lewis, company president, Dunkirk was chosen for the new plant because it is more centrally located with the company's present trend of business. About 40 persons, including many from the Toledo plant, will be employed in production at the Dunkirk location.

LASALCO APPOINTED PLATING DISTRIBUTOR

Lasalco, Inc., St. Louis, manufacturer of electroplating equipment, has been appointed regional distributor for Diamond CPA 1800, a chromium plating additive developed by the Chromium Chemicals Division of the Diamond Alkali Co., Cleveland.

PEOPLE

continued from page 31

Metalwash Machinery Corp. has announced the appointment of **Ralph C. Schwarz & Sons** as representatives to handle the Metalwash line of processing machinery in western New York.

Western Powdered Metal Fabricators Association has elected the following officers for the coming year: **Al Williams, Ceremet, Inc.**, chairman; **R. Remington, Picco, Inc.**, vice chairman; and **O. R. Bowen, Asco Sintering Co.**, secretary.

Owners and operators of the newly-formed *Progressive Foundry, Inc.* are **Philip G. Smith**, president; **Harold W. Schroeder**, vice president and general manager; and **Jack Bean**, vice president, secretary, and treasurer.

After 37 years of service, **Walton S. Smith** has retired as vice president in charge of manufacturing for *Metal & Thermit Corp.* Mr. Smith will continue as a director and consultant for the company.

The appointment of **Frank DeMatteo** as controller and chief accountant of *Shallway Corp.* has recently been announced. Mr. DeMatteo was an accountant with the Jeanette, Pa., Public Schools.

John Woodward has been appointed assistant general manager and **Byron E. Smith** has been named plant engineer for *Scott-Atwater Mfg. Co.* Both men have transferred from positions with McCulloch Motors Corp., which merged with Scott-Atwater earlier this year.

SPEED UP PRODUCTION with DOUBLE-ACTION DRYING

Air-dry as you spin-dry with the new, improved New Holland Model 20 KREIDER CENTRIFUGAL DRYER

• Now you can *spin-dry* small parts in continuous *fresh air* in as little as 15 seconds.

Double-action drying with peak-efficiency evaporation gives smooth moisture-free surfaces . . . reduces your finishing problems by eliminating the scarring frequently responsible for costly "rejects."

Your operators will be able to boost production, cut costs way down when you install New Holland's easy-to-run Model 20 Kreider Centrifugal Dryer.

SAFER because of Mechanical and Electrical Control Features!

To unlock cover and **remove basket, operator must depress foot brake, stop spinner.**

Machine cannot start with open cover. Ample clearance allowed for quick loading.

To start spinner, operator must first close cover completely.

SPECIFICATIONS:
1 h. p. motor—220, 440, 550 volts—2- or 3-phase—spins 75-lb. loads at 825 r.p.m. . . . Quiet V-belt drive . . . 30-blade suction turbine draws air through spinner . . . . Arc-welded steel-plate construction . . . Heavy-gauge woven steel mesh basket . . . Weight: 490 lbs. . . . Floor space: Just under 5 sq. ft. . . . Meets N.E.C. specs. **Optional:** J.I.C. Control: Mounted on right, left side or wall. 160° supplementary heat: 2350-watt Chromalox, or steam.

Send for illustrated 4-page folder. Address Dept. PM-100
New Holland Machine Company, New Holland, Pa.

NEW HOLLAND MACHINE COMPANY
NEW HOLLAND, PA.

For more information circle No. 89 on the Reader Service Card

DATA IN ADS

continued from page 22

80. Coating For Metals—Data sheets are available from The Chemical Corp. on their new Luster-On 50 powder for coating zinc or cadmium. Shipping economies and properties of the powder are listed.

81. Painting With Masks—Literature on spray masks, mask washers, automatic spray painting machines, and clamps and fixtures is available from Conforming Matrix Corp.

82. Barrel Finishing Compounds—A complete chart and data file on the proper barrel finishing compound for almost any part or material have been released from Esbec Barrel Finishing Corp.

83. Grinding Belt Unit—Two bulletins from Grinding & Polishing Machinery Corp. give full specifications and the many uses of the company's 6-72 belt unit.

84. Abrasive Belt Machines—Grinding, polishing, and deburring economy is said to be possible with the company's abrasive belt machines. A catalog on these machines can be obtained by enclosing your company letterhead with the advertisement from Hammond Machinery Builders, Inc.

85. Cut Buffing Costs—through use of "Liquimatic," a compound for all metal finishing. Full descriptive literature is available from Hanson-Van Winkle-Munning Co.

86. Threaded Inserts—Four bulletins on threaded inserts can be obtained from Heli-Coil Corp. One is an application chart and the other three are design data.

87. Low Cost Finishing—The advantages of barrel finishing to give hand-buffed results at barrel finishing costs are given in "Facts and Figures Report on Honite Barrel Finishing" from Minnesota Mining & Mfg. Co.

89. Small Parts Drying—A four page folder on the centrifugal, air drying of small parts has been issued by New Holland Machine Co.

91. Cleaners For Electroplating—of steel, brass, or zinc die castings are discussed in three booklets from Oakite Products, Inc.

93. Magnesium Dust Control—The "wet method" of magnesium dust collection and control is the best according to a new brochure from Peters-Dalton, Inc.

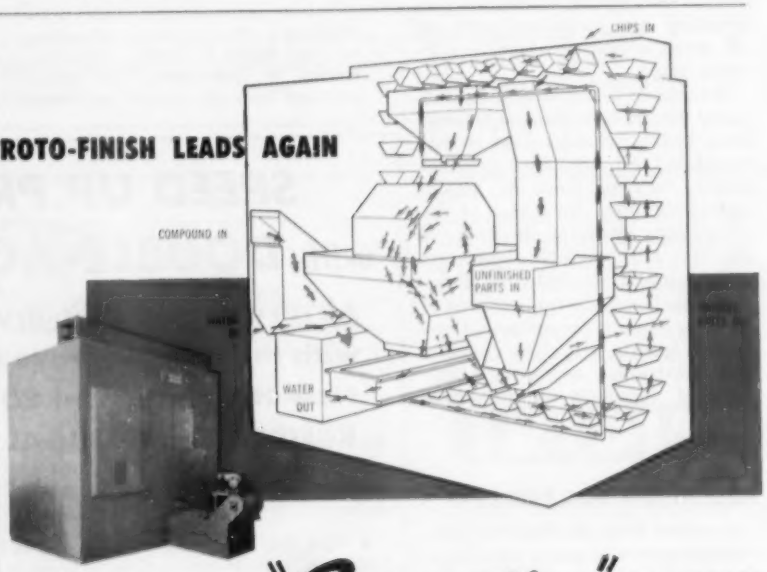
96. Bright Plating Processes—Details on gold, rhodium, and silver plating processes which require no burnishing or buffing are given in literature from Sel-Rex Precious Metals, Inc.

97. Barrel Finishing Media—Speed-D-Burr Corp. has a folder and catalogs available on barrel finishing machines, media, compounds, and material handling equipment.

102. Small Die Cast Parts—A bulletin is available from Gries Reproducer Corp. on their small parts die casting facilities as well as the new Intercast process for single-unit assembly.

NAMED DISTRIBUTOR

The Besly-Welles Corporation, South Beloit, Ill. has recently appointed the Libb Tool Co., Inc., 75 Laurel St., Hartford 6, Conn. as stocking distributor for the complete line of Besly cutting tools and gages.



ROTO-FINISH LEADS AGAIN

the new "Rotomation" MACHINE

MAKES MECHANICAL TUMBLING A FULLY AUTOMATIC BARREL FINISHING PROCESS

- Completely Automatic
- Needs no operator in attendance
- Loads and unloads itself with each cycle.
- Cycle variable for different part requirements.
- Provides continuous operation
- Assures uniformity of finish
- Low cost operation — high production
- Complete package unit
- Simple to install . . . Electric, water, air and drain connections only.
- Suitable for straight line production.
- Thus, "Rotomation" barrel finishing machine becomes a machine tool.

Roto-Finish COMPANY

3716 MILHAM ROAD, KALAMAZOO, MICH.

P. O. Box 988 – Phone 3-5578

ORIGINATORS OF THE ROTO-FINISH PROCESS

FOREIGN REPRESENTATIVES: CANADA — Toronto — Canadian Hansen & Van Winkle Co., Ltd., Car. Silver and Morrow Aves. ENGLAND — Mark Road — Hemel Hempstead — Hertfordshire — Roto-Finish Ltd. AUSTRALIA — Cheltenham, 89 Tulip St., A. Flavell Ltd. HOLLAND — BELGIUM — LUXEMBURG — Delft, Holland — N.V. Roto-Finish Maatschappij Rotterdamseweg 370A • AUSTRIA, GERMANY, SWITZERLAND, NORWAY, SWEDEN Frankfort a.M. — Metallgesellschaft A.G., Germany — Reuterweg 14 • ITALY — Milan — Societa Roto-Finish a R.L. — Sestos S. Giovanni — Viale E. Marelli 31 • FRANCE — Paris Societe Roto-Finish, 40-42 rue Chance Milly — Clichy, (Seine) • BRAZIL — Rio de Janeiro — Commercial E. Industrial de Formos Worco, Ltds. rua General Gurjao, 326 • SPAIN — Barcelona — Instituto Electroquimico, S.A. — Corcega 59.

For more information circle No. 95 on the Reader Service Card

NEW THREAD CUTTING FASTENER

- LOW COST
- RE-USABLE
- SELF-LOCKING
- VIBRATION-PROOF
- SPRING TAKE-UP

Pulls up tight without backup on flat or contoured surfaces

Specially designed to hold die-cast or cold-forged name plates, emblems and trim against sheet metal surfaces, DOT's new T. C. F. cuts clean, deep threads on unthreaded studs, even those that are chrome plated. Immediately available to fit 1/8" and 3/16" studs.

When used with its pre-assembled plastic sealer, the new T. C. F. makes a watertight seal. The sealer *precedes* the fastener onto the stud so that it is not damaged by the thread-cutting process.

Available *in quantity* with or without sealer from Monadnock Mills subsidiary and Carr Fastener Division.

United-Carr's design staff is ready to apply the same engineering creativity that produced the T. C. F. and thousands of other special-purpose fastening devices to the solution of your special fastening problems. Field representatives are located in most principal cities.

T.C.F. for 1/8" stud shown actual size. Also available for 3/16" stud.

T.C.F. for 1/8" stud with plastic sealer.

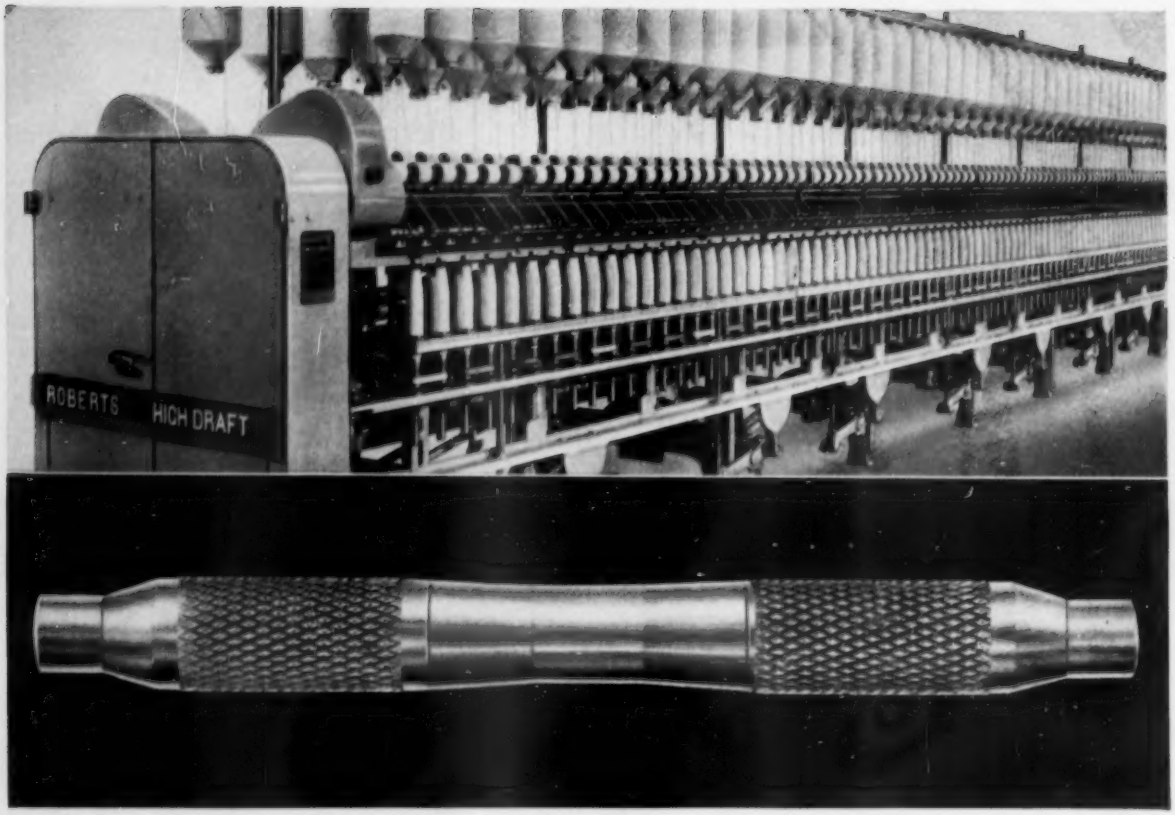
MONADNOCK MILLS
SUBSIDIARY
San Leandro, California

DOT T.C.F.
THREAD CUTTING FASTENER

CARR FASTENER CO.
DIVISION
Cambridge, Massachusetts

UNITED-CARR FASTENER CORPORATION

For more information circle No. 98 on the Reader Service Card



Roberts Co., internationally known textile machine maker

Improves finishes to 10 RMS... slashes costs $35.84 per thousand "top rolls"

Roberts Company of Sanford, N. C., specialists in spinning frames, was using polishing wheels and wire brushes to finish hardened steel top rolls—dry bearing components of its textile spinning machines. Costs were a high $39.40 per thousand finished rolls and the best finish obtainable by this method was an often unsatisfactory 50 to 60 micro inch.

A HONITE Field Engineer suggested that this company switch to the HONITE Barrel Finishing Method, using HONITE Compounds and HONITE Chips. The results: Costs per thousand finished top rolls immediately dropped to a low $3.56 . . . finishes improved to a high 10 micro inch *and* the life and lubrication requirements of the finished rolls increased a full 100%.

You can cut costs with the HONITE Barrel Finishing Method, too. Write today for full facts!

Honite® BRAND

Made in U. S. A. by
MINNESOTA MINING AND MANUFACTURING CO.
General Offices: St. Paul 6, Minn. In Canada: P. O. Box 757, London, Ontario. Export Sales Office: 99 Park Avenue, New York City.

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MINNESOTA MINING AND MANUFACTURING CO.
Dept. FF-106, St. Paul 6, Minn.

☐ I'd like to talk with a HONITE Field Engineer

☐ Send me FREE copy of booklet "Facts and Figures Report on HONITE Barrel Finishing"

Name_____ Title_____

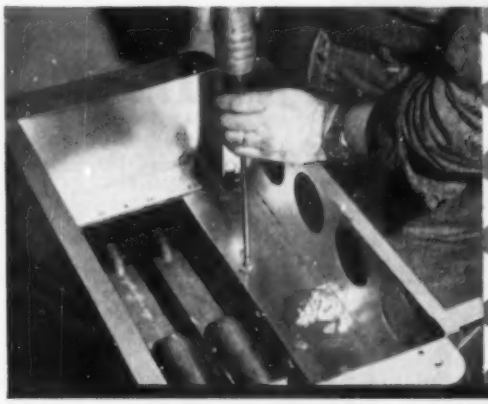
Company_____

Address_____

City_____ Zone____ State_____

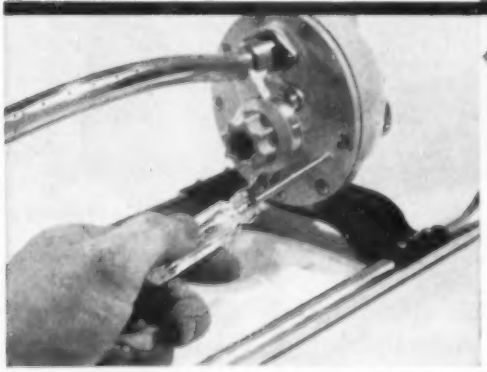
For more information circle No. 87 on the Reader Service Card

Investigate the assembly savings made possible by P-K® self-tapping screws



Because P-K Type A Self-tapping Screws have clean, deep slots and sharp gimlet points . . . and because they are consistently uniform, Reznor Mfg. Co. enjoys important savings in the assembly of their gas heaters.

To hold the plastic handle halves of their Instant Heat Soldering Irons together, The Lenk Mfg. Co. specifies P-K Type F Self-tapping Screws. No need for a separate tapping operation. Production is increased and costs reduced—thanks to P-K Screws.



Melnor Industries, Inc. (formerly Melnor Metal Products Co.) puts assembly strength into their famous "Swingin' Spray" oscillating lawn sprinkler by fastening zinc and aluminum parts with P-K Self-tapping Screws—7 Phillips Head Type Z and 18 Type F. They start right . . . drive right . . . and stay tight.

PARKER-KALON DIVISION, General American Transportation Corporation
Manufacturers of Self-tapping Screws, Socket Screws, Screwnails, Masonry Nails, Wing Nuts and Thumb Screws

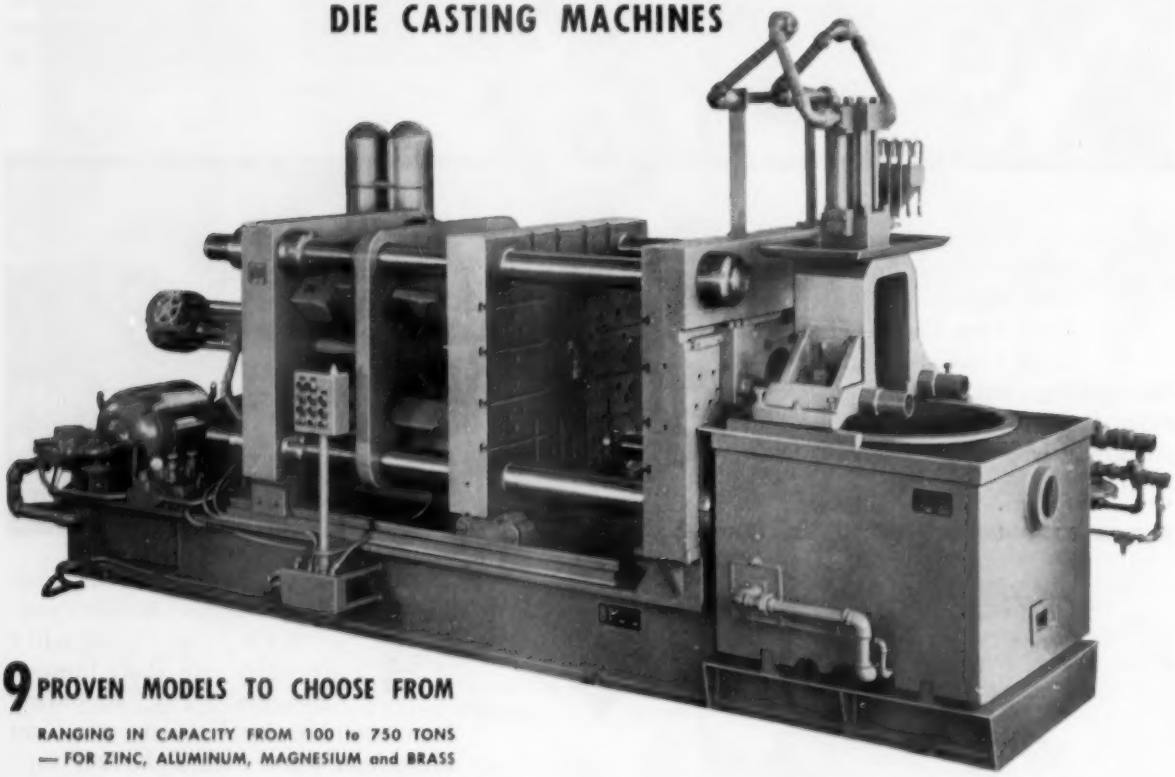
PARKER-KALON® fasteners

Sold Everywhere Through Leading Industrial Distributors
Factory: Clifton, New Jersey—Warehouses: Chicago, Illinois—Los Angeles, California

For more information circle No. 92 on the Reader Service Card

B&T DIE CASTING MACHINES

DESIGNED AND BUILT TO THE SPECIFICATIONS OF PRACTICAL, LONG-TIME DIECASTERS AND DEVELOPERS OF DIE CASTING MACHINES



9 PROVEN MODELS TO CHOOSE FROM

RANGING IN CAPACITY FROM 100 to 750 TONS
— FOR ZINC, ALUMINUM, MAGNESIUM and BRASS

B&T die casting machines operate with four extra heavy alloy steel casting toggles that lock directly under the tie bars. The hydraulic lines are of extra heavy seamless pipe; Weldon joints, flanged connections and "O" ring seals on pressure lines. Full specifications on all models furnished upon request. Consult with us on your requirements.

B&T MACHINERY COMPANY HOLLAND, MICHIGAN 201-217 EIGHTH ST. Phone 2341

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AN AFFILIATE OF BUSS MACHINE WORKS · MANUFACTURERS OF MACHINERY SINCE 1862

For more information circle No. 13 on the Reader Service Card

USEFUL LITERATURE, CATALOGS, MANUALS

any of these technical publications may be obtained by circling the appropriate numbers on the Reader Service Cards, Pages 16-17

PMM PROCESSES

Powder Metal Bibliography: 154
Harper Electric Furnace Corp., bibliography index. Prepared mainly for metal industry personnel unfamiliar with powder metallurgy, the publication refers to nearly 250 articles and papers printed in more than 50 technical journals, trade magazines, and business papers during 1954-55. In addition, general powder metallurgy references and currently used textbooks are listed.

Savings With Investment Casting: 155
Linton Precision Casting Co., 3-color folder. How production costs can be reduced by using the investment casting process is explained. Other advantages of the process and photographs of some investment cast parts are included.

Die Casting Service: 156
The Tool-Die Engineering Co., Inc., 4 pages, 2-color brochure. Photographs and information on the company's die and cast divisions and the parts they produce are presented. Composition and properties charts on die casting alloys are given.

Investment Casting Process: 157
Westinghouse Electric Corp., 12-page, 2-color bulletin 52-500. The application, advantage, and procedure of investment casting are revealed. A technical discussion on designing parts for production is presented and a series of charts on investment casting materials is included.

Zinc Die Castings: 158
The New Jersey Zinc Co., Vol. 24, No. 2 of The Alloy Pot. This external house organ is devoted to presenting the advantages of using zinc for die casting. Among the features in the current issue is a series of step-by-step photographs on the assembly of a cigarette dispenser which contains 23 zinc die castings.

MATERIALS AND EQUIPMENT

Tungsten-Point Etching Pencil: 159
Fansteel Metallurgical Corp., 4-page journal. This issue of "Fansteel Metallurgy" features an article on a tungsten-point etching pencil for marking a part number or identification code on a hardened steel tool or die.

Non-Corrosive Solder Fluxes: 160
Federated Metals Div., American Smelting & Refining Co., technical literature. Information is available on non-corrosive, quick wetting solder fluxes designed for use on copper and copper base alloys.

Centrifugal Casting Machine: 161
W. J. Hooker, Ltd., 1 page, engineering leaflet. A list of the specifications and features of a new centrifugal casting machine for investment casting is presented in this leaflet. The machine makes castings in molds having maximum dimensions of 8" x 5".

Die Casting Machines: 162
Lester-Phoenix, Inc., 9-page technical report. The important points to consider regarding permissible projected areas for die casting with Lester machines are discussed. Also given are engineering specifications on shot weights, injection pressures, and casting areas for various plunger sizes of the Lester machines.

High-Temperature Alloy: 163
Haynes Stellite Co., 10-page, engineering manual. A general description, mechanical properties, and rupture data on a wrought, nickel-base, aluminum- and titanium-bearing alloy are given in this booklet. The manual also gives the chemical composition, physical and high-temperature properties of this alloy, called R-235.

Endothermic Gas Producers: 164
General Electric Co., 4 pages, 2-color data folder. This folder gives application data, product descriptions, dimensions, ratings and diagrams of the company's Thermalene endothermic gas producers. Also included is operating data giving approximate gas costs based on materials consumed at rated output.

Electric Heating Furnaces: 165
C. I. Hayes, Inc., 4 folders. Descriptions, photographs, and specifications on the company's various types of electric furnaces are presented in one of the folders. New manual pusher furnaces are discussed in another. The other folders deal with the company's atmosphere equipment and laboratory facilities.

High Vacuum Furnaces: 166
F. J. Stokes Machine Co., 8-page, 2-color Bulletin No. 790. A discussion of the uses and applications of high vacuum furnaces is featured in this brochure. Diagrams and operating details on several of the company's vacuum furnaces are included as well as a list of the available types.

Vacuum Impregnation: 167
F. J. Stokes Corp., 21 pages, 3-color Catalog No. 760. This catalog contains a general description of vacuum impregnation — its applications, values, products, and processes. Specifications on the various Stokes impregnating equipment are given.

Ceramic Protecting Tubes: 168
Claud S. Gordon Co., 1 page, 2-color Bulletin No. 1000-56. An illustration and description of the Serv-Rite line of ceramic protecting tubes for thermocouples is presented in the bulletin. Listed are the various sizes of tubes available in the different materials and prices as well as general application data for the tubes.

Magnesium Dust, Fumes Control: 169
Peters-Dalton, Inc., 7-page, 2-color brochure. The "wet method" is best for collection and control of magnesium alloy dust and fumes, according to this brochure. Besides giving information on this method of protecting against possible magnesium processing hazards, the brochure describes the design and operation of several Peters-Dalton systems which employ the "wet method."

Continued next page

DO YOU NEED ANSWERS TO THESE QUESTIONS?

1 How can I electroclean steel at lower cost?

2 How can I find a brass cleaner that gives better protection against tarnishing?

3 How can I reduce rejects due to faulty electrocleaning of zinc die castings?

***Answer* 1** Following an Oakite recommendation, one plater made a small change in his steel-cleaning cycle and soon had two tankfuls of cleaning solution doing the work of three—and the plate adhesion was improved. *See booklet offered below.*

***Answer* 2** Oakite has a new brass cleaner that provides scientific protection against the oxygen that tarnishes brass and other copper alloys during the application of reverse current. *See booklet offered below.*

***Answer* 3** Oakite has an anodic conditioner that offers brighter plating of zinc die castings . . . with no anodic blackening and fewer rejects. *See booklet offered below.*

FREE For more information about the electrocleaning of steel, brass or zinc die castings, send for one or all of the booklets listed in the coupon.

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Surface Plate Calibration: **170**
Collins Microflat Co., technical article. "How to Calibrate Surface Plates in Your Plant" gives the step-by-step instructions for surface plate calibration after installation in the user's plant. The article explains how, by use of an auto-collimator and following the manufacturer's instructions, this method of calibration can be performed at any industrial laboratory.

Die Casting Machines: **171**
Cast-Master, Inc., 6 pages, 2-color brochure. The principal features and advantages of Cast-Master die casting machines are presented. Phantom drawings illustrate several hydraulic ejection systems, and optional safety and operational features of the machines.

Furnace, Oven Controls: **172**
Minneapolis-Honeywell Regulator Co., 44 pages, 2-color cond. bulletin and Price List B43-1. Complete price lists and engineering specifications for the company's many industrial furnace and oven control instruments are offered in this book. Among those described in tabular and paragraph form, are potentiometers, thermocouples, radiamatic units, and control valves.

Improved Appliance Finishing: **173**
Minnesota Mining & Mfg. Co., 10 pages, 4-color booklet. This booklet makes case history presentations of several abrasive operations by other companies, including pre-finishing, weld grinding and blending, removing imperfections, and finishing and polishing. Types of coated abrasives illustrated in use are belts, sheets, discs, and "PG" (polishing and grinding) wheels.

Continued on page 84

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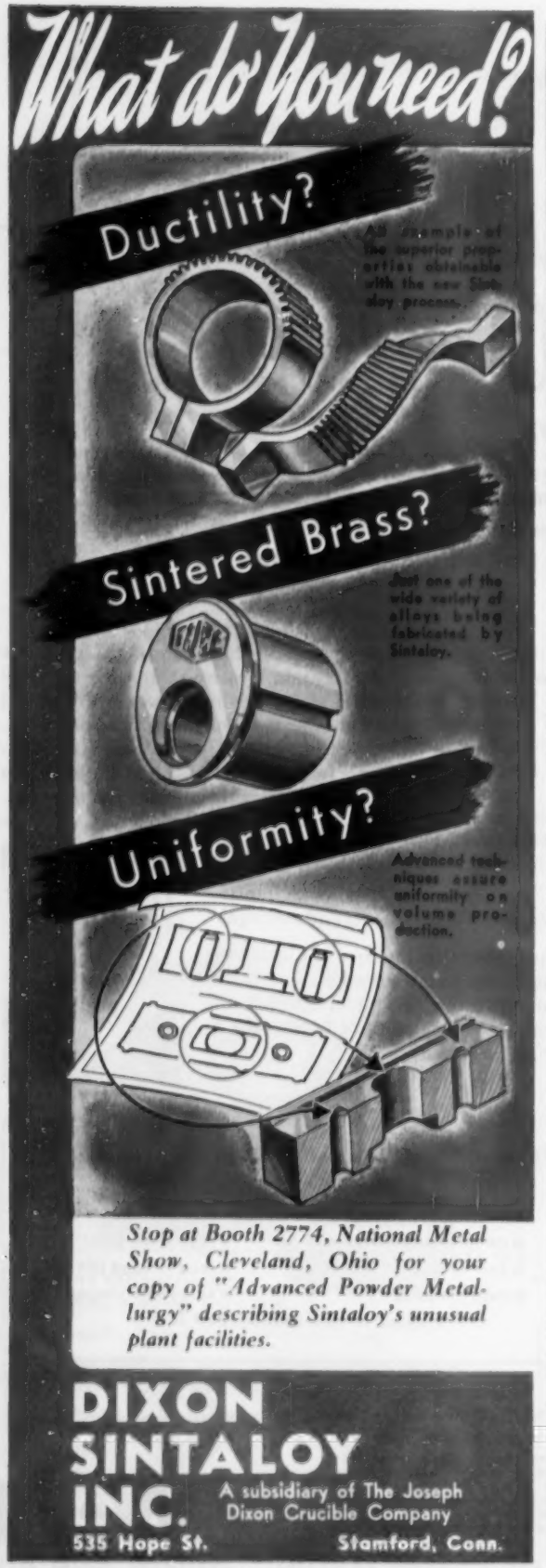
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FINISHING

Grinding Machine Modification: 192
Anocut Engineering Co., 4 pages, engineering bulletin No. 300. This technical bulletin outlines the procedures used in adapting any standard grinder for use with the Anocut electrolytic grinding process.

Plating, Polishing Report: 174
Hanson-Van Winkle-Munning Co., 4-page news sheet. Major achievements and refinements in the company's line of plating and polishing equipment are shown in this sheet. New cadmium and nickel plating processes are discussed and a complete list of prices of anodes, buffs, other polishers, and chemicals is available.

Metal Cleaners: 175
Hanson-Van Winkle-Munning Co., 2-page folder. The more recognized cleaning operations are covered in this bulletin. Brief descriptions that show the fundamental differences in the various operations are given and characteristics of H-VW-M's Matawan cleaners are presented. Also included is an application chart for the cleaners.

Carbide Grinding Wheels: 176
Robertson Mfg. Co., 2 pages, 2-color bulletin. This bulletin describes and illustrates the company's line of abrasives for carbide grinding tools. The literature contains information on standard wheel types and sizes for various operations. In addition, it furnishes wheel sizes, plate specifications, and Robertson blue print numbers of 23 plate-mounted vitrified wheels for 30 grinding machines made by 16 different manufacturers.

Backstand Idler: 177
Curtis Machine Corp., 1 page, 2-color sheet. The company's newest addition to its line of industrial abrasive belt grinding, polishing, and deburring equipment is described. The simplified design of this new backstand idler features a foot pedal for belt tension release, which leaves both hands free for changing the belt.

Die Castings Sander: 178
Brubaker Mfg. Co., Inc., 3 pages, 2-color folder. A brief description of the external, internal, contour, and precision sanding possible with a new sanding and deburring machine is offered. The belt on the new machine is driven by a contact pulley on the motor shaft, over an idler pulley on the end of a spring loaded column.

Glossary of Coating Terms: 180
Red Spot Paint & Varnish Co., Inc. 1 page, glossary sheet. This list of terms used in the coating of castings and plastics, and high vacuum metalizing coatings for plastics and metals is based on findings in the company's research center laboratory.

Water Spotting Preventive: 181
Oakite Products, Inc., folder No. F9822. As discussed in the folder, water spotting of metal after plating can be eliminated with the use of Rinsite, a new cleaner which makes the water drain uniformly from the metal.

Semi-Automatic Polisher: 182
Oswald Mfg. Co., 1 page descriptive sheet. Short-run as well as long-run production is possible with a new semi-automatic machine for finishing operations using buffs, set-up wheels, or belts. Set-up time from job to job consumes five minutes.

Continued on page 94

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BELT GRINDING

continued from page 68

identical for the other pump parts —motor brackets, sealing plates, and column flanges—surfaced on the Engelberg grinder. Two sizes of motor brackets are secured by the simple fixture, Figure 3. Stock removal required on the bracket's two longitudinal 1-1/16"-wide mounting ribs is .040-inches. Grinding rate is two minutes per piece, which permits an extended belt life of 150 brackets. The belt-ground face of the bracket is used as a locating reference when the parts are fixture-mounted in a turret lathe for subsequent machining of the round end.

Sealing plates used in other Graymills' pumps are also processed on the Engelberg grinder to relieve production on lathes. Stock removal of these gray iron parts runs as high as 3/32-inches. Although belt life in this operation is reduced to 35 pieces per belt, production rates have increased and surface flatness has been improved.

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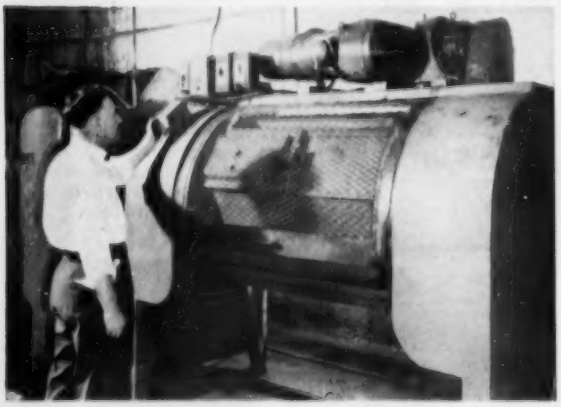

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WEAR BEHAVIOR

continued from page 41

phase are that it have low adhesive affinity as measured by the mutual solid solubility for the other surface, in this case a hardened alloy steel, that it be relatively soft, but not molten, at the temperature of operation, and that it can be replenished when worn away.

The conditions on the hard phase are that it be sufficiently hard to provide a small, true contact area, and that it does not interfere with the lubricant action of the softer phase. The results of the work suggest that other properties of the hard phase are also important.

The above are the most important requirements for a high performance bearing material. There are, in addition, a number of lesser ones such as conformability, both macro- and micro-, chemical and thermal stability, the right degree of surface reaction with the lubricant, and surface fatigue resistance. In the present instance, mechanical strength, impact resistance and thermal expansion relative to the race material also were important considerations for the bulk material.

As was noted previously, many materials were used in conducting the tests. The preparation of the specimen material was a major part of the overall program. In the initial phase of material screening, a number of commercially available alloys were tested including iron-silicon bronze with and without silver plating, "S" Monel, nodular iron, Ni-resist cast iron, Inconel, cast Inconel, and sintered iron product containing 4% MoS_2 and molybdenum sulphide.

One premise that had been established earlier was that a class of heterogenous materials would be more desirable and these had to be fabricated on an experimental basis. These materials, as it turned out, consisted of nickel or nickel base alloy skeletons containing various additives, which were formed by pressing and sintering appropriate metal powders and additions, and subsequently infiltering these sintered skeletons with silver or silver base alloys. Both the sintering and infiltration were carried out in an atmosphere of dried hydrogen.

Continued next page

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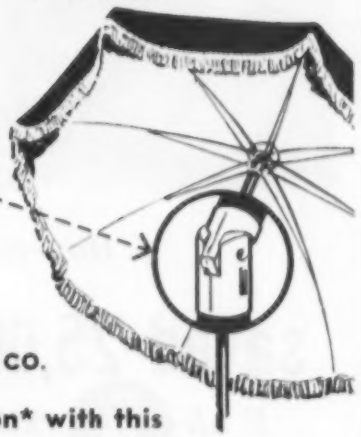

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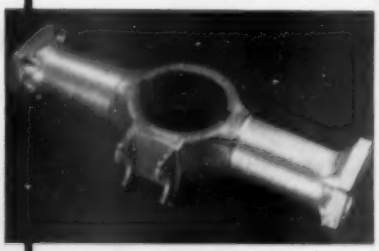
*As told in Iron Age Magazine — August 2, 1956



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The compositions of the most significant materials tested are listed in Table 1.

Because of the complex nature of galling wear, the evaluation of test results in a program of this type is not a simple problem. Hence, it is felt that there is no single property which, when measured on the test machine used, necessarily gives an accurate indication of the susceptibility of the material being tested to cause failure in service. Rather, the results of the tests of each material are largely in the nature of a collection of observations of one or more characteristics which could be detrimental to the performance of the bearing and tend to lead to trouble in service.

In some instances, it is excessive wear of the test retainer material; in others it is the pick-up of the retainer material on the rotor, thus leading to severe vibration. In still other cases there is either scoring of the rotor surface, excessively high friction, or excessive temperature rise. Obviously, any of these conditions, if severe, militate against successful performance under the critical conditions imposed by the type of service.

How the materials compared

For reference purposes and to arrive at a standard for subsequent tests, runs were made with specimen of iron-silicon bronze and silver-plated iron-silicon bronze (0.002 silver plate) which are presently used in service. Runs were made with an oil temperature of 220 F and average specimen temperature of 350 F.

The iron-silicon bronze specimen showed breakdown after an average of 3½ minutes running with galling, wear and pronounced pick-up on the disc. The behavior of this material was dependent on the temperature. One specimen was run at a temperature of 360 to 365 F, and at the end of one hour was not worn appreciably, although some scoring was evident. However, when the temperature of the specimen was increased to 380 F, very severe galling occured with considerable vibration due to scoring and pick-up on the disc. Tests on this material were then discontinued.

Tests on the silver-plated iron-silicon bronze specimen indicated

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that a major improvement was accomplished by the presence of silver. The tests were run at temperatures of 330 F and 430 F, with the plating being worn through after less than 67 minutes and 6½ minutes of testing, respectively. As long as the plating was intact, however, the friction was low and the vibration was nil, reflecting low pick-up and scoring of the disc. The only drawback of silver plating under the present testing conditions appears to be that it wears off, thus rendering the material ultimately no better than its substrate.

Sintered iron coated with Teflon and iron-silicon bronze coated with an epoxy resin in which graphite was dispersed both lost their coatings practically immediately.

This work led to the conclusion that if any material is found to perform well temporarily as a coating, it would seem preferable to disperse it throughout the retainer material structure. In particular it was concluded that silver might have considerable merit as a dispersed soft phase.

The remaining materials examined fell into four basic groups: cast and wrought materials; molybdenum sulphide impregnated materials; miscellaneous alloys; infiltered sintered materials.

In the first category, the iron base materials were characterized by unusually high friction as well as scoring and pick-up on the disc. Included in the nickel and copper base alloys were "S" Monel, Inconel, cast Inconel, two-copper base alloys, the already mentioned iron-silicon bronze and a lead bearing bronze.

The results of the wear tests on "S" Monel at various temperatures were superior to those obtained on iron-silicon bronze in some respects. Although the former showed greater increase in wear rate with increasing temperature than the latter, there was less metal transfer and subsequent vibration with the "S" Monel composition. Since both are standard cage materials in present day bearings, the other materials tested in the program are compared to them in the accompanying graphs.

A run using Inconel at 380 F resulted in a severely scored disc and considerable metal transfer in a short running time. A specimen of cast Inconel containing 3% silicon was tested and found far superior to wrought Inconel in its wear behavior. The test was run at 450 F and was characterized by no vibration and low wear rate.

Results obtained with lead-bearing bronze indicated that the material has little potential value at higher temperatures.

In testing the miscellaneous alloys, a copper-aluminum-silver alloy showed very high wear rate and resulting severe vibration. A second alloy, similar to this with an addition of 4% silicon was induction melted and cast. It was run at 650 F and compared favorably with other promising alloys. It performed far better than that with no silicon added. Continued investigation of this material seems desirable.

A magnesium base alloy containing silver and zirconium ran fairly smoothly, but the wear rate exceeded that of other materials tested. A silver base alloy containing cadmium oxide had a low wear rate but produced severe vibration and rotor scoring. An alloy containing 65% tungsten carbide and 35% silver was tested at 615 F. It showed a low wear rate and no vibration or scoring of the disc. Time did not permit additional testing.

Two sintered specimens impregnated with molybdenum disulphide were tested and discarded after producing severe vibration, galling and scoring.

In attempting to design a promising composition, three basic

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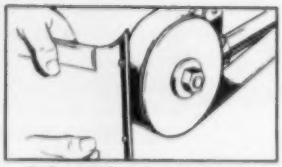

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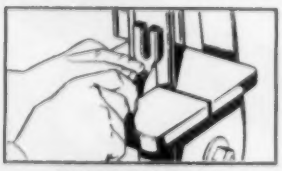

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conclusions reached up to this point were incorporated:

1. Silver should be an effective soft constituent in a duplex structure against a steel in this temperature range.

2. The duplex structure should have a soft phase dispersed through the hard matrix rather than coated on the surface so that it can be replenished when worn through.

3. Since "S" Monel performed fairly well for a single phase material and currently is used in service, it should prove a promising material for the matrix.

After tests of silver infiltered "S" Monel and plain "S" Monel, a specimen of 48% chromium, 48% nickel, and 4% silicon metal compact was infiltered with silver. This specimen displayed better overall wear properties than any previously tested materials. Therefore, a new series of compositions to be made by powder metallurgy techniques suggested themselves.

The above composition was varied somewhat by an 8% silicon and a 10% molybdenum disilicide addition and this specimen produced severe vibration when tested.

Three specimens of "S" Monel base compacts were made up with 4% and 8% silicon and 10% molybdenum disilicide and the compacts were infiltrated with silver. All three compositions reacted similarly. There was no scoring and the tests were smooth until the pick-up on the disc was sufficient to cause vibration. The 8% silicon addition improved the wear rate, and the 10% $MoSi_2$ addition wore only slightly more at higher temperatures than the latter. In all cases the wear characteristics were superior to plain cast "S" Monel.

Nickel base compacts plus silicon powder were infiltrated with silver and tested. The 4% silicon addition resulted in better wear rates than any of the above mentioned materials. The specimen containing the $MoSi_2$ proved better than the one containing the 4% silicon. The 8% silicon compact had an even lower wear rate, but slight vibration and scoring were evident throughout the testing temperature range.

The conclusions drawn from the testing are as follows:

1. Several alloy compositions have been developed which have superior elevated temperature wear resistance compared with standard bearing cage alloys such as "S" Monel and iron-silicon bronze. All of the promising materials except one contain silver as a major constituent.

2. It has been established that the addition of from 2 to 4% silicon to the nickel-base phase is distinctly beneficial to the wear properties of several classes of metallic alloys, whether cast or fabricated by powder metallurgy techniques.

3. It has been shown that the alloy composition can be varied considerably with respect to the strong, load-supporting phase as long as silver is contained in the soft matrix. For instance, promising results have been obtained with nickel base alloys formed by powder metallurgy techniques, with cast alloys containing copper and aluminum, and with tungsten carbide, all containing silver as a major constituent.

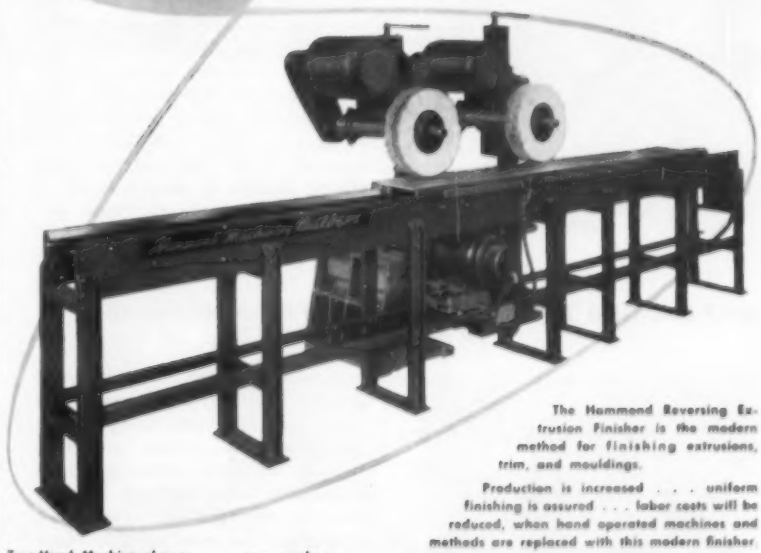
OPEN GEORGIA OFFICE

The opening of a new southeastern office at 522 N. McDonough St., Decatur, Georgia, for the sales-engineering of Ross heat exchange equipment, has been announced by Ross Heat Exchanger Division of American-Standard. Fred M. Mahan is manager.

Hammond OF KALAMAZOO

REVERSING EXTRUSION FINISHER

for LOW COST, VOLUME PRODUCTION FINISHING OF EXTRUSIONS, TRIM AND MOULDINGS



The Hammond Reversing Extrusion Finisher is the modern method for finishing extrusions, trim, and mouldings.

Production is increased . . . uniform finishing is assured . . . labor costs will be reduced, when hand operated machines and methods are replaced with this modern finisher.

Two-Head Machine shown . . . any number of heads, and length of conveyor, can be supplied to suit your job.

SEND SAMPLES and we will show you how much you can speed up production and cut costs.

Hammond Machinery Builders Inc.

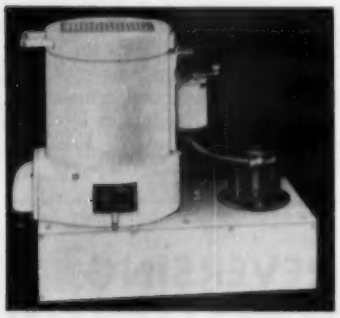
1642 DOUGLAS AVE. • KALAMAZOO, MICHIGAN

For more information circle No. 99 on the Reader Service Card

NEW PRODUCTS AND DEVELOPMENTS

Want complete details on these announcements? Use the Reader Service Cards. You'll find them facing page 16 of this issue

BELT-DRIVEN DRYER HANDLES 70 LB. OF WORK



A new belt-driven centrifugal dryer with claimed advantages of sound engineering, simplicity of design, compactness, economical operation, and important safety features has been introduced.

Mounted on a heavy base, the dryer is driven by two standard V-belts which are powered by a totally-enclosed ball bearing, vertical flange mounted motor. This design is said to prevent moisture from entering the motor.

The dryer basket revolves at approximately 500 rpm and will handle work loads up to 70 lbs., depending on size and type of work being processed.

Heated dryers are furnished with red covers as a safety measure to warn the user against touching a hot cover. Both heating elements and motor drive are automatically controlled by a heavy duty reversible switch.

The dryer may be electrically heated by means of a turntable furnished with a suction fan mounted to draw air down through the work from an opening in the cover, where the electric heating element is located.

Hanson-Van Winkle-Munning Co.
For more information, circle No. 205 on the Reader Service Card

MAGNETIC CHUCK SPEEDS MICRO-HOLE DRILLING

A new, precision micro-drill which features a magnetic chuck for speeding up difficult micro-hole drilling down to .001, has been announced.

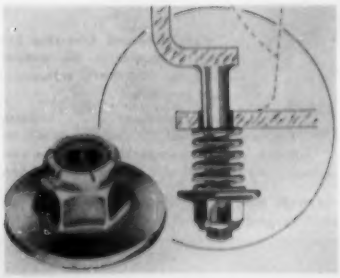
Collets used with the chuck take most commercially available micro-drills with shank sizes of .030, .040, and .061, thus eliminating the need for special drills. Two magnetic drivers with variable holding power are provided to fit into the chuck. Drills are inserted into the collets and placed against the magnetic drivers which hold these assemblies in drilling position.

A calibrated micrometer depth control, employing a knurled feed ring, permits positive stop at exact depth required within .0002. It provides a means for drilling blind holes to extremely close tolerances.

Another feature is the two-way table travel provided as standard, built-in equipment on the unit. Two large dials indicate travel which is controlled by convenient knobs for quick location and exact spacing between holes.

The Dumore Co.
For more information, circle No. 207 on the Reader Service Card

SELF-LOCKING NUT DESIGNED FOR SPRING MOUNTING



A new, flanged hexagon self-locking nut with a large washer-type seat, has been designed for fastening applications involving spring tension. Manufacturers claim the large built-in bearing area of the ESNA Type 1994, eliminates the need of individual nuts and special washers in such applications.

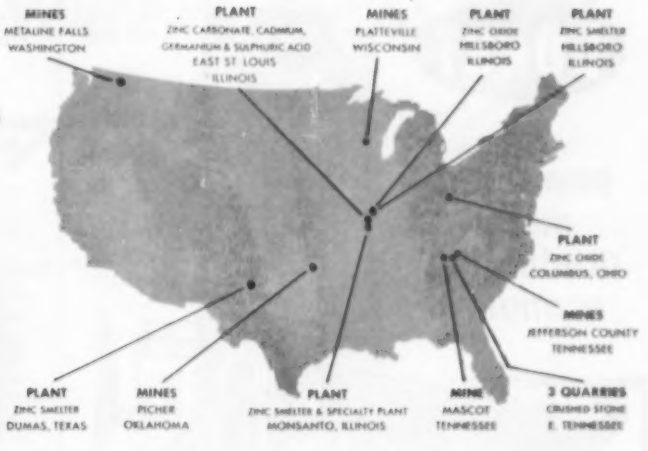
During shipment of a spring mounted unit, the nut can be turned down by compressing the spring, thus making a solid mounting which cannot shift. As a self-locking fastener, the 1994 will remain locked at any desired position on the bolt permitting exact spring tension adjustment.

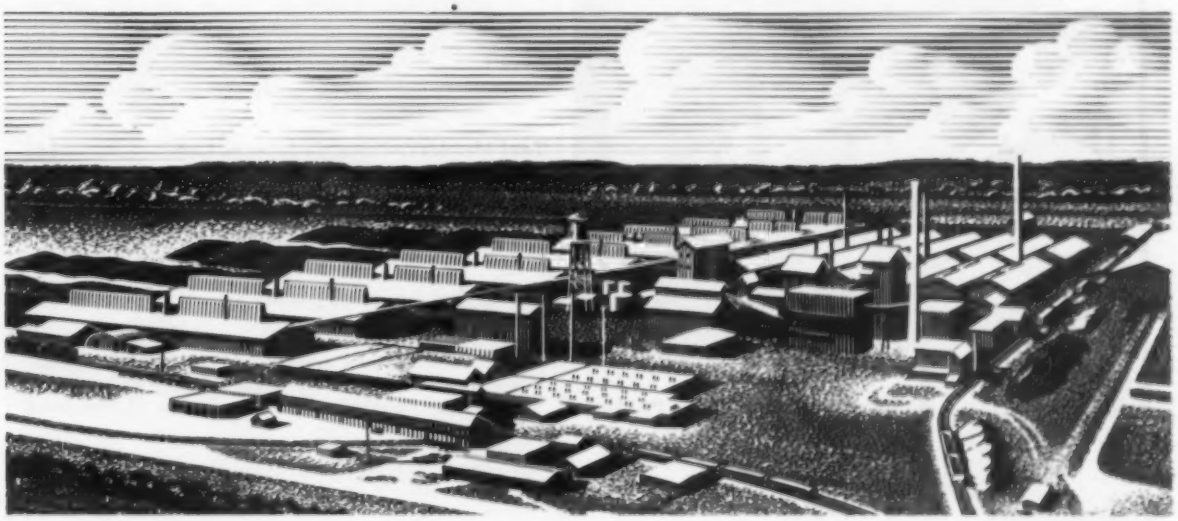
The new nut, made from steel with a plain or plated finish, is 1″ in diameter.

Elastic Stop Nut Corp. of America
For more information, circle No. 206 on the Reader Service Card

Continued on page 97

American Zinc and its products *from* A *to* Z





SMELTER AT DUMAS, TEXAS

Dumas is one of the larger horizontal retort furnace plants in the United States. Here are produced Prime Western, Select, Brass Special and Intermediate grades of slab zinc for the galvanizing and brass industries. Roasting and sintering operations are also carried on at Dumas, making this plant an important factor in the widespread American Zinc picture.

PRODUCERS OF

ALL GRADES OF SLAB ZINC
ZINC ANODES (Plating & Galvanic)
METALLIC CADMIUM
SULPHURIC ACID
LEAD FREE and LEADED ZINC OXIDES
ZINC CARBONATE
GERMANIUM DIOXIDE
AGRICULTURAL LIMESTONE
CRUSHED STONE

Distributors for

American Zinc sales Company

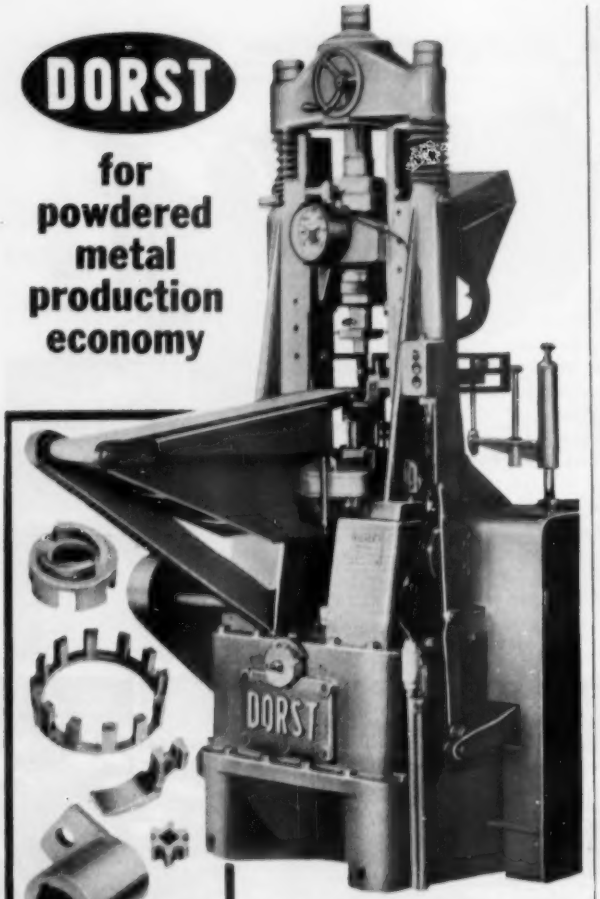
AMERICAN ZINC, LEAD & SMELTING COMPANY

Columbus, Ohio • Chicago • St. Louis • New York • Detroit • Pittsburgh

For more information circle No. 9 on the Reader Service Card

DORST

for powdered metal production economy



DORST AUTOMATIC PRESS TYPE DA

These are fully mechanical presses with hydraulic pressure indicator, utilizing a tooling system with full "floating-die" action and enabling the manufacturer to make parts to close dimensional tolerances. Dorst's compacting process assures uniform density and conformity from piece to piece in production runs. This tooling and compacting method has been recognized by leading authorities in this field for many years the world over.

FEATURES:

- High depth of fill from 5⅛" to 7-1/16" depending on size of press.
- Extremely simple set-up and change-over makes these presses economical for large and small runs.
- Optional equipment: Synchronized conveyor belt and pick-up mechanism to transfer fragile pieces to conveyor belt or to lift pieces from die cavity.

We have engineering facilities to aid the manufacturer in the production of intricately shaped forms, especially in the design and manufacture of tools. **Available sizes: 15, 25, 50 and 110 tons.**

Write TODAY for complete technical data

ARNHOLD CERAMICS, INC.
DORST DIVISION
Sales and Engineering Organization for U. S. and Canada
1 East 57th Street, New York 22, N. Y.

For more information circle No. 11 on the Reader Service Card

USEFUL LITERATURE

continued from page 84

Silver Plating Process: **183**
Sel-Rex Precious Metals, Inc., 8-page technical paper. A new bright silver plating process is said to give a mirror bright finish directly from the bath through a complete range from flash to extra heavy deposits, and produces hard, highly ductile deposits.

Rust Preventive Base: **184**
E. F. Houghton & Co., Data sheet No. 2-459. This sheet contains complete information, including physical properties and typical applications, on Rust Veto M. P., a multi-purpose, rust preventive base. Considered especially economical when mixed with water, this inflammable emulsion can be used to replace dangerous solvents or similar flammable slushes.

Wet Blasting Process: **185**
Cro-Plate Co., Illustrated folders. Detailed descriptions of a variety of applications for the Pressure Blast wet blasting process are available in this series of folders. Material deals with deburring, selection of abrasives, finishing of molds and dies, cleaning prior to electro-plating, etc.

Tool Holders, Carbide Inserts List: **186**
Besly-Welles Corp., 8-page Catalog 852C. A listing of the company's complete line of tool holders and triangular and square throwaway carbide inserts has been released. Complete details on styles, sizes, and prices are given.

Barrel Finishing Equipment: **187**
Speed-D-Burr Corp., 4 catalogs. Detailed, illustrated explanation is presented on the many types of barrel finishing equipment available to manufacturers. Among subjects covered are production cost savings, media and compounds, and the company's lines of equipment.

Spray Painting Selection: **188**
Finish Engineering Co., Inc., 32 pages, multi-color catalog. A guide is offered for selecting the best spray gun action, type of mask, or other equipment for the particular part to be spray painted. Illustrations demonstrate, step by step, the use of painting fixtures, and the use of screens and fixtures for the silk screen process.

Finishing Machinery: **189**
Hammond Machinery Builders, Inc., 23-page, Catalog No. 60. The company's complete line of grinding, polishing, and finishing machinery is presented. Descriptions, specifications, and photos of dust collectors, automatics, lathes, abrasive belts, etc. are given.

Carbide Cutting Tools: **190**
Elgin National Watch Co., 7 pages, 2-color brochure. This industry-service booklet presents Elgin's complete line of solid carbide end mills, rotary files, and miniature cutters, and explains the use of each. Also included are several tables explaining speed range in various metals, and a cutting conversion chart.

Nickel Undercoating For Rhodium: **191**
Sel-Rex Precious Metals, Inc., Technical literature. Information has been published on the production of compressively stressed nickel coatings for use specifically with rhodium. The new process counteracts rhodium electroplate's inherent tendency to cracking and peeling when used as an undercoat. It also eliminates peeling and curling common in precision components that have been plated with ordinary tensile stressed metals.

New LINDBERG–FISHER Autoladle

We call it "LITTLE JOE"

Here, for the first time, is a ladling unit that makes automatic casting of aluminum not only possible but practical. The Autoladle has been thoroughly tested and proven in service.

"LITTLE JOE" provides these advantages:

- Adaptable to induction, electric resistance or fuel-fired reverberatory furnaces.
- Ladled metal is withdrawn from beneath surface of bath.
- Precise, accurate control of any size shot up to 30 lbs.
- No interruption of the casting cycle during charging of metal.
- No variation of size of shot due to metal level changes.
- Composed of special refractory materials so arranged that ladled metal cannot come in contact with any metal.

To the best of our knowledge this is the first practical automatic ladling unit yet devised. It will fill an important need in many casting operations. For complete information, get in touch with your nearest Lindberg Field Representative (see your classified phone book) or write direct.

You can see "Little Joe" in operation at the Metal Show in Cleveland.

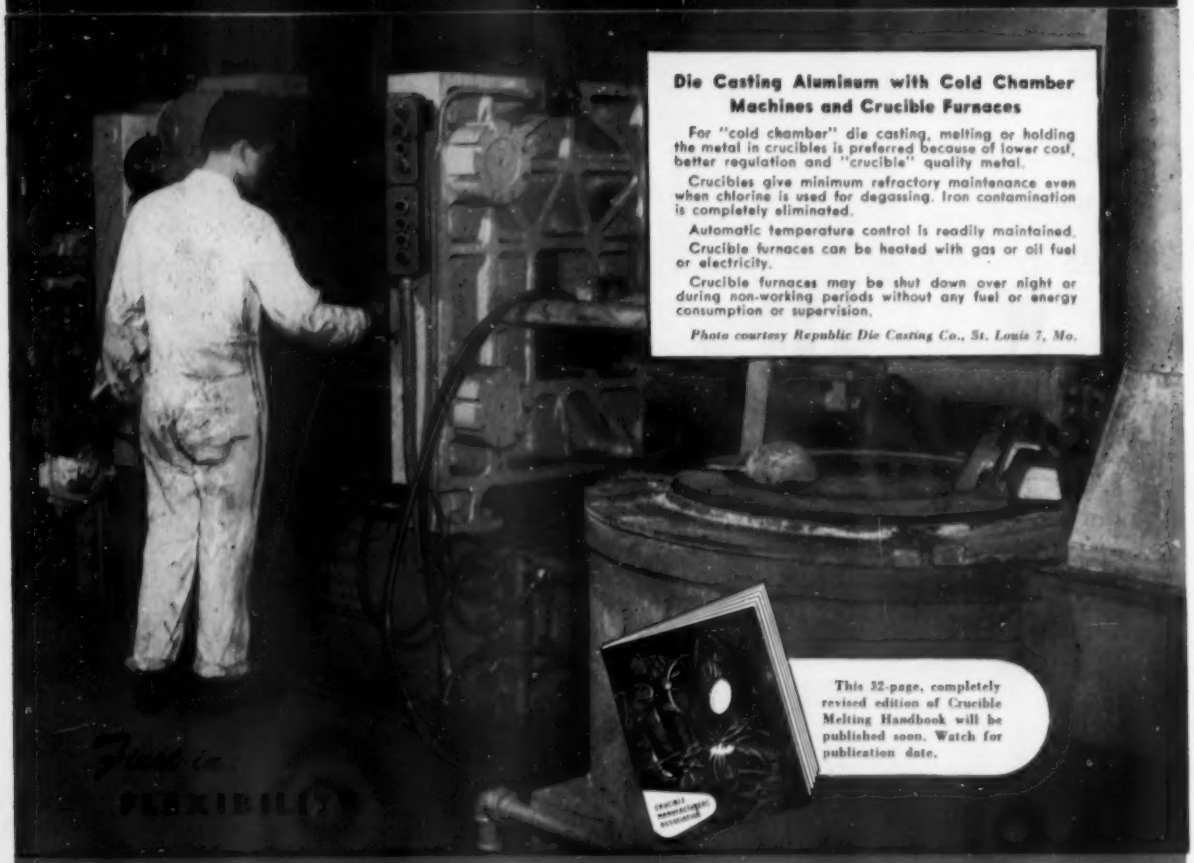
LINDBERG FISHER

MELTING FURNACES

A Division of Lindberg Engineering Company, 2463 West Hubbard Street, Chicago 12, Illinois

For more information circle No. 47 on the Reader Service Card

CRUCIBLE melting



Die Casting Aluminum with Cold Chamber Machines and Crucible Furnaces

For "cold chamber" die casting, melting or holding the metal in crucibles is preferred because of lower cost, better regulation and "crucible" quality metal.

Crucibles give minimum refractory maintenance even when chlorine is used for degassing. Iron contamination is completely eliminated.

Automatic temperature control is readily maintained.

Crucible furnaces can be heated with gas or oil fuel or electricity.

Crucible furnaces may be shut down over night or during non-working periods without any fuel or energy consumption or supervision.

Photo courtesy Republic Die Casting Co., St. Louis 7, Mo.

This 32-page, completely revised edition of Crucible Melting Handbook will be published soon. Watch for publication date.

CRUCIBLE MANUFACTURERS ASSOCIATION

29 W. 42rd STREET, NEW YORK 36, NEW YORK

CRUCIBLES FOR FLEXIBILITY

THESE FIRMS CAN TAKE CARE OF ALL YOUR REQUIREMENTS FOR CRUCIBLE MELTING

VESUVIUS CRUCIBLE CO.
AMERICAN REFRACTORIES & CRUCIBLE CORP.
ELECTRO REFRACTORIES & ABRASIVES CORP.
JOSEPH DIXON CRUCIBLE CO.
ROSS-TACONY CRUCIBLE CO.
LAVA CRUCIBLE-REFRACTORIES CO.

For more information circle No. 24 on the Reader Service Card

NEW PRODUCTS

continued from page 92

FLEXIBLE GRIND WHEEL . . . for varied surfaces

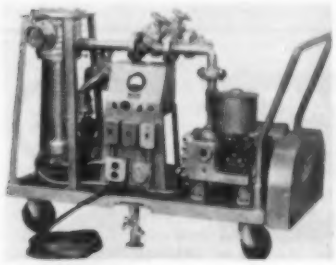
A soft, pliable abrasive wheel has been specially designed for work where rigid grinding wheels cannot be adapted. Called a grinding mop by the manufacturer, the wheel is made up of a multitude of flexible abrasive strips mounted radially in a hub.

The mop is attached to the machine with special flanges and will conform itself to the shape of the work after a short time. It is said to be particularly suitable for removing parting line flash or performing other clean-up jobs on die castings.

C. Klingspor G.m.b.H.
For more information, circle No. 213 on the Reader Service Card

PORTABLE VACUUM PUMP . . . for low-pressure

Designed to attain absolute pressures as low as 10^{-6} mm. Hg., a portable high vacuum pumping system has been produced for



laboratory work, pilot plant operations, and small scale production applications.

The new mobile system employs a fractionating 4-inch diffusion pump, connected to a 15 CFM two-stage roughing and backing mechanical vacuum pump.

The unit is recommended for use in exhausting 10 to 15 cu. ft. chambers for vacuum distillation, impregnation, coating, degassing, stress, relieving, etc.

Kinney Mfg. Div.,
The New York Air Brake Co.
For more information, circle No. 214 on the Reader Service Card

MULTIPLE DRILL HEAD . . . for 8 jobs at once

A flexible shaft driven adjustable spindle drill head has been

Continued next page

For more information circle No. 12 on the Reader Service Card

speaking of quality . . .

PREALLOYED STAINLESS STEEL POWDERS

by AMP

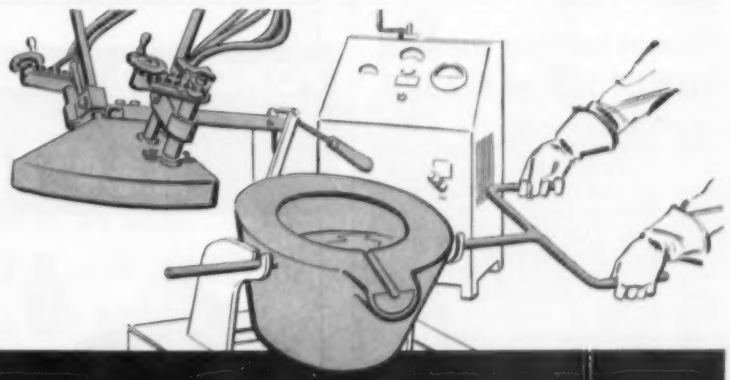
For Outstanding Structural Parts, Porous Media and Self-Lubricating Parts Requiring Any or All of These Properties . . .

- SUPER-CORROSION RESISTANCE
- HEAT RESISTANCE
- HIGHER DENSITY
- HIGH DEGREE OF HARDNESS
- HIGH IMPACT STRENGTH
- HIGH TENSILE STRENGTH

9 Standard AISI Alloys To Choose From

WRITE TODAY FOR FULL DETAILS

ALLOY METAL POWDERS, INC.
producers of
prealloyed metal powders and pigments
234 EAGLE STREET • BROOKLYN 22, NEW YORK



15 lb., 12 kw. Pot-Tilting DETROIT ELECTRIC FURNACE

—research and small production tool

A versatile furnace! Converging indirect arc electrodes force arc down over metal for fast melting. Cover lifts and swings aside for charging and pouring. Pot can be transported or tilted to pour from stand. Permanent lining or removable crucibles. Complete with power and meters in separate cabinet.

Write today for complete information on Type PT Detroit Electric Furnace.

DETROIT ELECTRIC FURNACE DIVISION
KUHLMAN ELECTRIC COMPANY
1070 26th St. • BAY CITY, MICHIGAN

Foreign Representatives: In BRAZIL—Equipamentos Industrias, "Elsa" Ltd., Sao Paulo; CHILE, ARGENTINA, PERU and VENEZUELA: M. Castellvi Inc., 150 Broadway, New York 7, N. Y.; MEXICO: Cia Provesdora de Industrias, Atenas 32-13, Apartado 27A3, Mexico 6, D. F., Mexico; EUROPE, ENGLAND: Birlec, Ltd., Birmingham.

For more information circle No. 44 on the Reader Service Card

NOW...
a Skimmer
that really
SKIMS!
from
Spincraft

Skimmers and Ladles available in STAINLESS STEEL and MILD STEEL

In answer to continued requests from hundreds of its ladle customers, Spincraft has added a line of truly superior skimmers. Designed after extensive research, Spincraft Skimmers meet die casters' skimming requirements. The shallow radius "skims" instead of "ladles" as deep-cupped skimmers do. Correct size perforations prevent clogging. Handle stub fits common pipe—attach a handle of exactly the type and length you want. Diameters: 6", 8", 10" and 12".

SPINCRAFT LADLES
for non-ferrous metal pouring

Light, tough, long-lasting — designed to reduce operator fatigue, minimize spillage and improve heat transfer. In 23 sizes, from ¼ lb. to 30 lbs.—with or without handles. A die-casting *must*.

Write for complete data and prices on ladles *and* skimmers TODAY.

Spincraft
SKILL WILL DO IT
INCORPORATED

4138 W. State St., Milwaukee, Wis.

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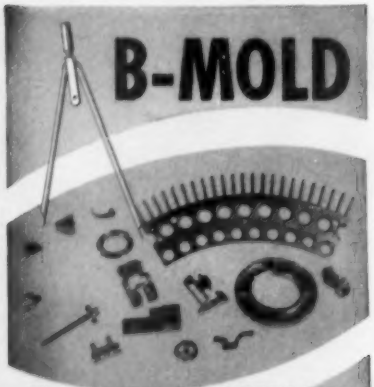
Circle No. 15 on the Reader Service Card

B-MOLD



PRECISION NON-FERROUS PERMANENT MOLD
CASTINGS

Aluminum Bronzes, Manganese Bronzes, Yellow Brasses, Beryllium Copper and Aluminum Alloys

Consult our Engineering Department, without obligation.

B-MOLD DIVISION
Buckeye Brass & Mfg. Co.
671 N. Main St. • Mansfield, O.

announced that is extremely lightweight and compact. It is designed for both tapping and drilling up to 8 holes simultaneously on any drilling or tapping machine.

The design, featuring the use of flexible shaft drives, permits a wider range of hole patterns with a smaller drive to spindle distance than conventional geared or universal joint spindle adjustable heads. The flexible shafts have been developed specifically for tapping and drilling and will operate at high speeds without vibration or danger of unraveling.

Ettco Tool Co.
For more information, circle No. 223 on the Reader Service Card

PAINT HANDLING PUMP . . . withstands solvents

A new pump now available has been engineered specifically for the rapid and economical handling of bulk paints.

The pump has been built of materials which are resistant to paint and paint solvents. It can be used on either large or small circulating systems.

The DeVilbiss Co.
For more information, circle No. 215 on the Reader Service Card

POWDERED METAL PARTS BY Remet

We can reduce your costs and improve your product with the advantages of the powdered metal process. Our modern plant and technical facilities are at your disposal to meet your most exacting parts requirements. Your inquiry is solicited for study and quotation.

WRITE FOR FREE FOLDER

Remet
REESE METAL PRODUCTS CORPORATION
537 Howard Ave., Lancaster 10, Pa.

TYPICAL PARTS:
Gears, pinions, cams, ratchets, bearings and bushings, machine and structural parts.

SPECIAL, high speed rotary presses available for high quantity, small part production

For more information circle No. 66 on the Reader Service Card

LIGHT GEARS

continued from page 39

primary consideration. Here, the die casting process provides the margin of difference by minimizing or eliminating machining, assembling or surface finishing.

A number of products in current production incorporate die cast aluminum or magnesium gears. Several of these, made by Litemetal Dicast, Inc., are illustrated and described.

TEETH WITHOUT DRAFT have been obtained by specifying die cast magnesium for certain of the cog-belt gears used in modern power transmission systems. Here, the use of magnesium alloy permitted the die caster to machine the die cavity without draft to meet the requirement.

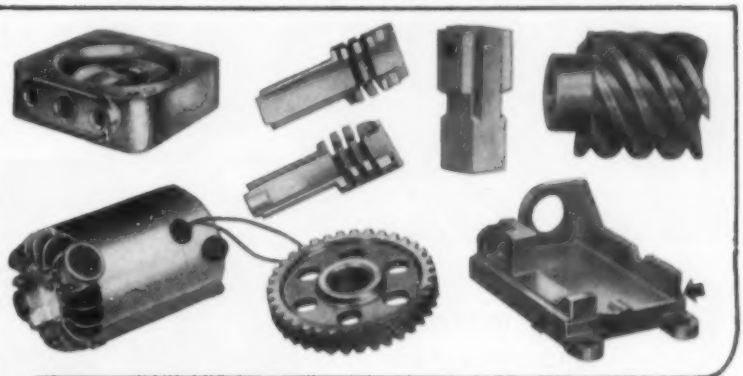
To save the cost of trimming dies, these castings have been edge gated on the outside face of the gear; a simple facing operation removes all flash. But edge gating presented a problem in obtaining the tolerance on roundness due to a greater tendency of the casting to shrink at the gate. To compensate for this, the die caster built the die with a calculated out-of-roundness so that the actual castings meet roundness tolerance of .003.

PLANETARY GEARS for lawn mowers have been produced from both aluminum and magnesium alloys, depending upon the special requirements. Since the casting is formed *over* a solid core, some draft is needed, even for magnesium alloys; the draft for aluminum must be increased somewhat, also, to prevent binding over the core. However, the magnesium alloy needs only about one-third the draft of the aluminum alloy.

The magnesium planetary, shown at the left, page 39, runs against a powdered iron pinion and has excellent wearing qualities. Operation is very quiet. Although greater draft is allowed on the aluminum gear, this is not of any great consequence, since it runs against a molded nylon pinion which has a matched taper. Aluminum was chosen here because the gear forms the exposed exterior surface of the lawn mower. Its appearance and resistance to corrosion without protective treatment were considered in its favor. A groove cast around the rim serves as a seat for the lawn mower's tire.

TO RESIST SALT ATMOSPHERE, the bevel gears for an outboard motor have been die cast in aluminum alloy. These matched sets of bevel gears have the accuracy and strength to meet the required service, and, in addition, can withstand exposure to salt-laden water.

For more information circle No. 52 on the Reader Service Card



DIE CAST PARTS *to Your Specifications*

A pioneer in the die casting art, *Milwaukee* has long been a recognized leader in supplying *Die Castings as Specified* to all types of industry for all types of products from small precision instruments to massive heavy duty machinery. That is why you can entrust *Milwaukee* to produce die cast parts to your most exacting specifications — not only in dimensions — but in contour, weight, strength, pressure resistance, wear resistance, finish and other vital characteristics.

We Operate under the Certified Zinc Plan of the American Die Casting Institute, Inc.

MILWAUKEE DIE CASTING COMPANY
4146 N. HOLTON STREET • MILWAUKEE 12, WISCONSIN
Established 1909

NEW!

HIGH SPEED A.B.C. DIE CASTING MACHINE

Free Cycles Over 1000 Shots Per Hour

Here's the new A·B·C high speed, low cost die casting machine which eliminates costly production of small die castings on large die casting machines. Air operated, the machine produces small non-porous lead, tin and zinc alloy precision die castings up to 1½ lbs.

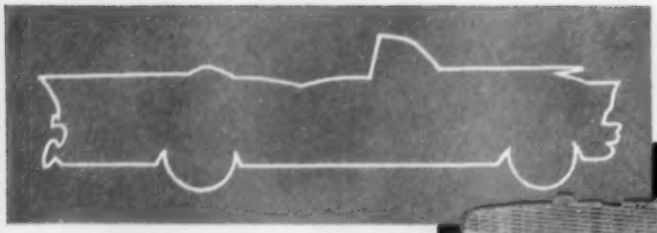
The A·B·C is economical to operate and easy to set up. Its lightning production speeds makes single cavity molds practical and profitable.

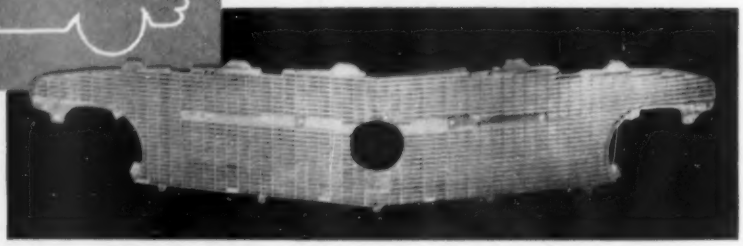
STANDARD EQUIPMENT INCLUDES:
- 4 TIE BARS
- AUTOMATIC TIMING
- CALIBRATED TEMPERATURE GAS CONTROL
- GAS BURNERS
- DIE BLOCKS
- AIR REGULATOR
- FILTER
- OILER
- SAFETY SHOT INTERLOCK

Write today for engineering data and prices. Ask for bulletin A-10.

A B C DIE CASTING MACHINE CO.
400 E. 142nd ST. • DOLTON, ILL.

For more information circle No. 1 on the Reader Service Card



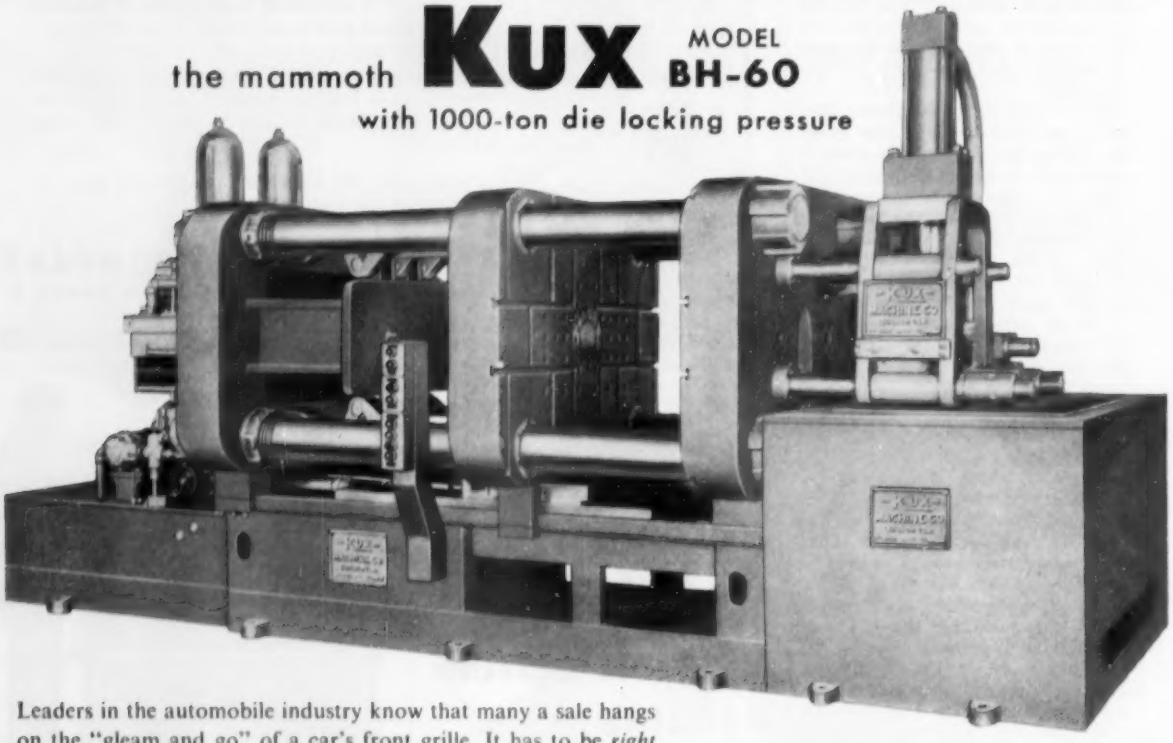


One of motoring's smartest new front grilles

cast on America's outstanding die casting machines

the mammoth **KUX** MODEL **BH-60**

with 1000-ton die locking pressure



Leaders in the automobile industry know that many a sale hangs on the "gleam and go" of a car's front grille. It has to be *right* for looks, for strength, for serviceability. And equally important, it must be engineered to allow for speed of production.

That's why the industry's top designers depend upon Kux quality die casting equipment to turn out the handsome new front grille illustrated above.

The grille weighing 24 lbs. in zinc, cast in one piece, measures 59" x 12" and is produced at an average speed of 80 per hour. The die, in which this part is made, is 70" x 50", and requires tremendous pressure to keep it locked under the force of the metal being injected. Therefore, the BH-60 machine having 1000 tons die locking capacity is utilized for this all powerful job.

Through the years, innumerable other leading manufacturers and die casters have profited from their acquaintance with the advanced die casting machines perfected by KUX. Why shouldn't you?

MODEL BH-60

Kux Hydraulically Operated Plunger Gooseneck Die Casting Machine for the Production of Lead, Tin or Zinc Castings

Also Available as HP-60, a Cold Chamber Model for the Production of Aluminum, Brass or Magnesium Castings

KUX

MACHINE COMPANY

6725 North Ridge Avenue, Chicago 26, Ill.

Builders of a full range of die casting machines . . . from 25 tons to 1000 tons in size.

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AMERICAN DIE CASTING INSTITUTE PLANS AGGRESSIVE MARKETING PROGRAM; MEMBERSHIP REACHES NEW HIGH

A continuation of its aggressive marketing and promotional program was planned by members of American Die Casting Institute when it held its 29th annual meeting in Chicago last month. Highlights of the three-day sessions include presentation of the Doehler Award, election of officers, report on the Institute's research program and discussion of stepped-up promotional work.

AWARD WINNER

Austin T. Lillegren

TOP AWARD given each year by the die casting industry, the Doehler Award, went this year to Austin T. Lillegren, vice president of Madison-Kipp Corp., for his outstanding contributions to the die casting industry during the past year. Mr. Lillegren is a past president of the Institute, a director, and an active leader of the Institute's Research Foundation.

THIRD TERMER

William J. During

REELECTED PRESIDENT for a third term was William J. During, president of Precision Castings Co., Div. of Harsco Corp. Serving with him will be C. J. Sheehan of the Die Casting Division, Aluminum Company of America, named vice president of the Institute. David Laine was reelected secretary and W. J. Parker, treasurer.

The National Board of Directors is elected by the four ADCI Regional Groups.

Pacific Coast Regional Group Directors are: Paul Bock, Los Angeles Die Casting Co.; P. T. Harlow, president, Rangers Die Castings Co.; and A. W. Simpson, III, president, Western Die Casting Co.

The Eastern Regional Group Directors are W. J. During, president, Precision Castings Co., Division of Harsco Corp., W. G. Newton, Jr., president. The Newton-New Haven Co.; and C. J. Sheehan, Alcoa.

L. L. Charlson, president, Char-Lynn Company; C. W. Omann, president, Advance Tool and Die Casting Co., and R. C. Strassman, treasurer, Badger Die Casting Co., are the representatives of the Midwestern Regional Group.

The Central Regional Group board members are H. H. Weiss, president, The Superior Die Casting Co.; George Ralls, president, Pressure Castings, Inc., and R. A. Luedtke, president, Schultz Die Casting Co.

VICE PRESIDENT

C. J. Sheehan

The Institute's Directors-at-Large are C. L. Anthony, The Hoover Company; F. W. Burgie, Doehler-Jarvis Div. of National Lead Co.; R. A. Peters, New Products Corp.; and L. G. Vanderhoof, vice-president, Stewart Die Casting Division of Stewart-Warner Corp.

Directors (past national presidents) are A. T. Lilligren, vice-president Madison-Kipp Corp., and H. F. Schroeder, president, Milwaukee Die Castings Co.

NEWCOMERS TO ADCI are ten companies admitted to membership. Total number of job shop die casters now enrolled is now 111 companies operating 121 plants. New member companies are: Titan Metal Manufacturing Co., Bellefonte, Pa.; Peasley Products, Inc., Stratford, Conn.; Falconer Metal Specialties Co., Inc., Lakewood, N. Y.; Gerity-Michigan Corp., Adrian, Mich.; Schultz Die Casting Co. of Canada, Ltd., Wallaceburg, Ontario; Jet Die Casting Co., Chicago, Ill.; Delta Die Casting Corp., Schiller Park, Ill.; Coast Die Casting Co., Culver City, Calif.; Commercial Die Casting Co., Los Angeles, Calif.; Peat Manufacturing Co. Division Of Textron, Inc., Norwalk, Calif.; and the Westland Die Casting Division, Westland Tool Manufacturing Co., Los Angeles, Calif.

RESEARCH being pushed by the Institute's Die Casting Research Foundation is reported to be moving ahead rapidly toward the ultimate objectives of improving die life to make the die casting of copper base alloys economically sound. Eventually, it is believed, the ferrous alloys may also be die cast. Encouraging progress along these lines, as a result of work being done at Battelle Memorial Institute, was reported.

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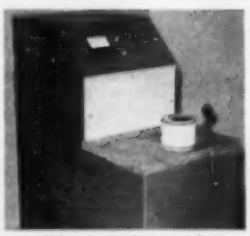

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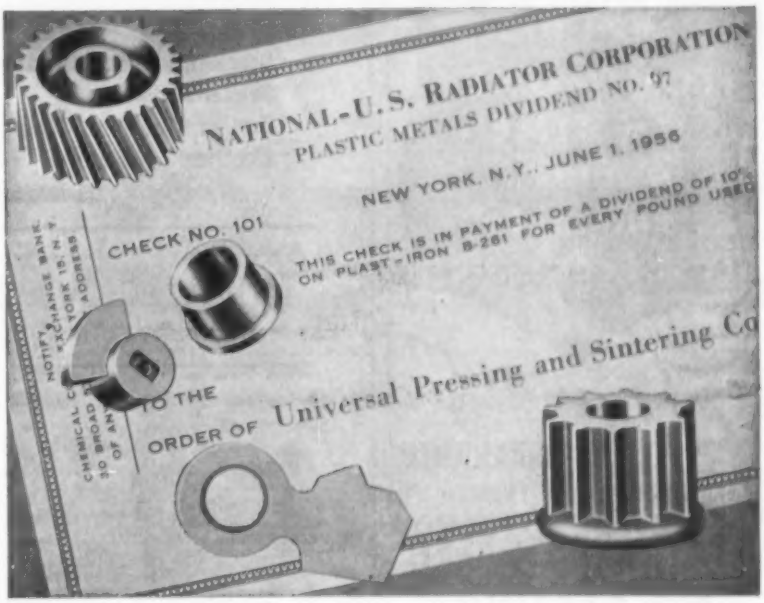
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How To Control Temperature In Die Casting Dies

Part 4 – Water-Cooled Sprue Bushings

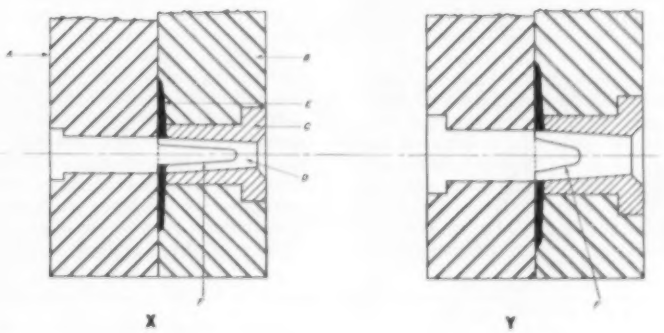
By W. M. HALLIDAY

WITH almost every kind of die casting die — simple or complex, single or multi-impression, large or small — it is necessary to employ some means for improving the flow of the molten alloy stream passing through the sprue channel. It is particularly important to apply such flow promotion means at the instant the alloy charge leaves the exit end of the sprue channel to pass into the various runner channels branching out to feed the die cavities.

This need is probably greatest with center sprue type dies, ie where the sprue channel is perpendicular to the main parting-joint surface of the stationary die-block, within which the channel is wholly contained. To a lesser extent, the need arises in the case of split or side sprue type dies where the sprue channel lies parallel with the main parting-joint and is split in half along its length in an axial direction by such parting line.

With dies having a center sprue, when the die-blocks are brought into the closed position for the injection cycle, the mouth of the sprue channel is almost entirely blocked-off by the closely contiguous parting-joint surface of

Continued on page 107



TYPICAL SPRUE PIN DESIGNS

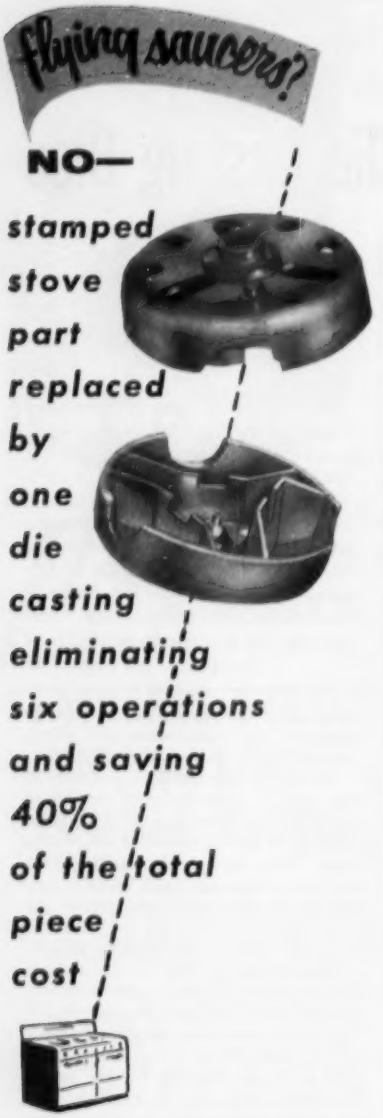
1. Referring to diagram *X*, members *A* and *B* are the movable and stationary die-blocks respectively, shown in the closed position, as for casting. The sprue bush *C* is affixed in block *B* and extends flush to the parting-joint surface of that member as shown. A standard tapered form of sprue channel *D* is provided up the center of this bush. Runner channel *E* cut across the parting-joint surface of the block, also passes across the end-face of one sidewall of the bush *C* to give the opening required to feed the cavity.

The 'distributor-pin' *F* is made in a high heat-resistant alloy steel, suitably hardened. It is affixed within the movable block *A* having its long conical portion projecting perpendicular to the parting-joint surface of that block. This portion of the pin passes centrally up the sprue channel when the blocks are closed, as here shown. The surfaces of the pin must be smoothly polished and its tip well rounded to present the minimum frictional resistance to the flowing alloy charge. Several unsatisfactory design features are possessed by the type of 'distributor-pin' shown at *X*. For example, the projecting conical portion of the pin is formed to the same side taper as that of the sprue channel. This greatly tends to reduce the deflecting properties of the pin in diverting the flow of the alloy stream to the mouth of the sprue channel. It is always best policy to make the angle of the 'distributor-pin' much steeper than that of the channel.

Moreover, the conical portion of the pin is unduly long extending as it does almost up to the nozzle seating at the rear end of the sprue bush. This means in practice that the tip of the pin will become exceedingly hot, and because of its small diameter it will be difficult to apply any efficient cooling means.

The conical portion of the pin is also too small in diameter in comparison with the long length, resulting in the pin being relatively weak and slender. Thus it is liable to distort, erode or fracture far too easily for satisfactory service use. The mass of metal contained in such a long delicate pin is also insufficient to insure effective heat dissipation.

A much preferred design of 'distributor-pin' is shown in the diagram *Y*, Figure 1. The length of the conical portion of pin *F* is reduced to somewhat less than half the length of the sprue channel in which it is contained. The maximum diameter of the conical portion is much larger than with the previous example at *X*, and the angle of taper is more than twice that on the sides of the sprue channel. This ensures a strong, rigid pin having a cross-section of considerable size and containing a substantial mass of metal. The heat diffusion capacity of such a pin will be much superior to that of a long slender pin such as shown at *X*.



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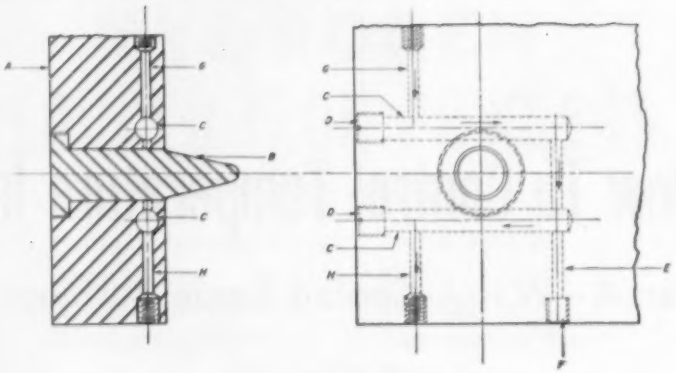
SPRUE-PIN DESIGNS—continued



SIMPLEST AND CHEAPEST

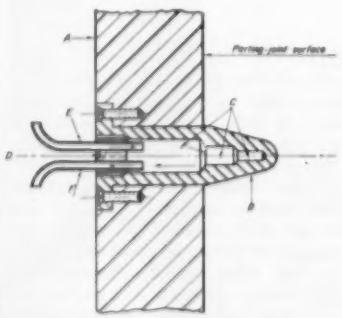
2. With this example, *A* is a cross-sectional view of the movable die-block into which is fastened the pin *B*. This member is of standard construction and shape and is left solid. All the adaptations for cooling are applied to the die-block.

These adaptations comprise the two large diameter drilled (blind) holes *C* which are machined perpendicular to one vertical side of the die-block so as to lie parallel with each other. They are situated one above the pin *B*, the other an equal distance below such pin, as shown by light broken lines in the right-hand diagram. These holes are located as close to the parting-joint surface of the block as practicable, and extend a sufficient depth to pass well beyond the pin. The mouth of each hole is enlarged and threaded to receive a sealing plug *D*.

Near their blind ends the two holes are connected together by a smaller hole *E* drilled at right angles and started-in from the bottom side of the die-block. The bottom open end of this third hole is tapped out for a sealing plug *F*.

Hole *G* drilled from the top side of the die-block and passing into the uppermost horizontal hole *C* is the inlet for the water supply. The mouth of this hole is enlarged and tapped for an ordinary nipple-connector to which may be attached a flexible rubber hose or other kind of pipe for feeding purposes. A similar size outlet hole *H* is drilled from the bottom side of the die-block to be in vertical alignment with inlet hole *G*, but passing into the lower horizontal hole *C*.

A nipple-connector is screwed into the mouth of this hole against the bottom edge of the block to receive a drain-off tube. The small arrows indicate the direction of water flow through these channels when the die is in operation. Water circulates around three sides of the 'distributor-pin' and the adjacent regions of the die-block.



MORE EFFICIENT

3. The movable die-block *A* is fitted with the headed 'distributor-pin' *B*, the latter being retained by means of a series of screws passing through the head portion. The interior of the pin is substantially removed by boring a hole of several diameters as at *C*. The purpose of this kind of hole is to leave a fairly uniform wall in the projecting conical portion.

The smallest diameter hole passes well into the rounded tip of the pin, it will be specially noted. The largest size hole at the headed end of the pin is threaded to receive screwed plug *D*, which is fitted to ensure a tight water seal. Closely fitted into this plug are the two metal tubes *E* and *F*. The former is the inlet tube and it is bent upwards at a point just outside the pin to give a downward flow of water to the interior of the pin. The outlet tube *F* is bent downwards at a corresponding external point so that the emitted stream of steam flows harmlessly downwards away from the externally situated die mechanisms. The inner ends of the tubes project the same short distance into chamber *C*. The arrows show direction of flow.

HEAT CONTROL

continued from page 105

the movable die-block which seals around the mouth of the sprue channel. The only outlets remaining for the flowing alloy charge are the runner channels leading out of the sprue channel.

In comparison with the area of the latter at its mouth, however, the size of the runner channels is relatively small — often minute. Thus considerable restriction is imposed on the flowing alloy at this point. Moreover, when the alloy stream reaches this restricted point, it has to undergo a sudden, rapid and often violent change in direction to pass into the runner channels.

In actual practice, when the incoming stream of hot alloy impinges against this sealing surface of the movable die-block only the *outer layers* of the stream can flow readily into the runner channel or channels. The main internal core layer of the stream is in effect turned back upon itself. Therefore, unless some means is provided for deflecting or spreading-out the flowing alloy stream at this critical stage violent turbulence occurs.

The effect of this turbulence may be serious, extensive and often exceedingly troublesome to eliminate. Innumerable objectionable features may accrue particularly with the regular operation of the die and the development of puzzling irregularities with finished die cast parts.

Some of the chief troubles and faults likely to arise from this source are:

1. Some of the turbulence occurring at the blanked-off mouth of the sprue channel is transmitted to the outer layers of the alloy stream when restriction to flow is less severe. The turbulence may, in fact, be carried through to the runners and critical cavity region.
2. If the latter condition should develop, trouble would be experienced in filling-out the cavity to produce completely formed castings, eliminating trapped-air porosity, and avoiding certain surface blemishes on castings.
3. The velocity of that portion of the alloy stream entering the runner channels is greatly reduced, with the resultant risk of reduced density of internal structure in finished castings.

Continued next page

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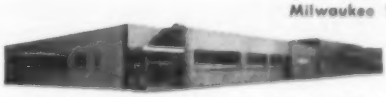

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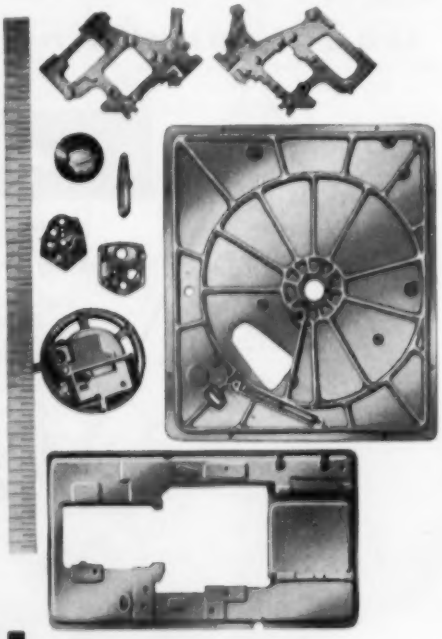

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HEAT CONTROL—continued

4. Some of the increased heat accumulating in the 'dammed-up' molten alloy at the mouth of the sprue channel is conveyed to that portion of the stream passing into the runners. Thus the temperature of the charge injected into the cavity zone will tend to fluctuate and to rise much above the optimum level required for efficient continuous casting.

5. The surrounding walls of the die-blocks which adjoin the sprue channel tend to grow increasingly and often intensely hotter than the other more remote portions of the blocks. Unless the localized build-up of heat is effectively dissipated the affected portions of the die-blocks speedily become overheated. Lack of such means for ameliorating this overheated condition, renders it still more difficult to establish and maintain a uniform, stable working temperature throughout.

To avoid this troublesome operating condition — and the kind of adverse effects just described — it is customary die design practice to employ a 'sprue-post' or a 'distributor-pin' in conjunction with the sprue channel. The diagrams at Figure 1 show typical designs of these pins, from which their mode of operation and advantages and limitations will be clearly understood. The illustration *X* Figure 1 depicts an unsatisfactory form of 'distributor-pin' which should be avoided; diagram *Y* shows the form of pin which is much to be preferred.

The chief functions performed by such a 'distributor-pin' are:—

(a) To deflect the flowing stream of molten alloy so as to impart a more gradual change in the direction of its flow,

(b) To ensure that this change of direction occurs at a point well down the sprue channel at a considerable distance away from the outlet of the sprue channel,

(c) To reduce turbulence in the flow at the mouth of the sprue channel so that the alloy stream passes smoothly into the runner channels,

(d) To prevent the main internal layers of the alloy stream from damming-up against the adjacent parting-joint surface of the movable die-block which blanks-off the sprue channel,

(e) To simplify the removal of the waste alloy solidified in the sprue channel after each shot,

(f) To afford the die casting engineer a convenient means for regulating die heat over this critical zone.

At any given instant during the injection cycle a considerable volume of hot molten alloy is contained in the sprue channel. This part of the charge is normally the last to cool and solidify owing to its closeness to the injecting nozzle and metal pot of the machine. The speed of its solidification relative to that of the alloy casting in the die cavity must be carefully controlled.

This point is essential in order that the die may be opened within a reasonably short time (a few seconds) after completing the injection 'shot', so as to insure the waste alloy in the sprue-stalk is sufficiently set and tightly shrunk onto the 'distributor-pin' so that it will draw out of the sprue channel with the pin when the die-blocks are separated.

The various ways in which a 'distributor-pin' may be adapted to achieve the above objectives most efficiently, chiefly by heat regulation, are illustrated in Figures 2-5.

The 'distributor-pin' in any die generally has to be cooled to draw-off or distribute excess heat. The manner in which this is performed quite frequently exerts a great influence upon the rate of temperature rise occurring over the associated regions of the die.

Because of its conical external shape the pin presents to the flowing stream of alloy a superficial surface area wholly disproportionate to its metal mass. The leading rounded end of the pin, which is of relatively small area, and which meets first each incoming layer of hot injected alloy, quite often attains a temperature equal to — and sometimes higher than — that of the alloy charge.

An overly hot 'distributor-pin' has poor diffusion properties; thus in general the smaller the size of pin employed the greater is the need for cooling means to redress the disproportion between metal mass and surface area.

It is usually found most expedient and inexpensive from the standpoint of heat regulation to employ water-cooling provisions with the sprue 'distributor-pin' etc. The diagrams given at Fig. 2 illustrate perhaps one of the simplest and most economical design lay-outs of a water-cooling

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Fire Resistant Hydraulic Fluids—
Coolants — Lubricants —
Water

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(cutaway)

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Meet J.I.C. Standards

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(cutaway)

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REDUCE MAINTENANCE

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PMM-10
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☐ Catalog 5200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
☐ Catalog 5400—For Fire-resistant Hydraulic Fluids (Synthetic)
☐ Catalog 5301—For Water

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HEAT CONTROL—continued

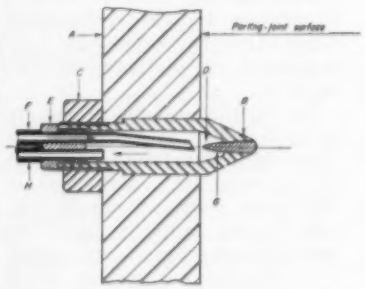
system for use with a common center-sprue type of die.

This method is certainly extremely simple and economical to install into a die construction, but it is not particularly effective, especially in cases where numerous cavity impressions and a complex runner lay-out is employed in the die. It will be understood that the two main water-cooling channels *C* traverse for the major portion of their length parts of the die-block from which it is unnecessary to withdraw heat. Only a relatively short portion of each of these channels is situated near enough to the fixed 'distributor-pin' to be of any practical value in diffusing heat.

Another disadvantage of this method is that those portions of the parting-joint surface of the movable die-block which lie immediately above the main water channels will be excessively cooled throughout the full lenght of such channels. Should these portions of the die-block pass over restricted runner or gate channels cut into the adjoining parting surface of the stationary die-block, the alloy feed through such runners and gates may be unduly retarded because of the freezing action of the chilled surface.

The rate of heat dissipation will inevitably vary considerably at different radial points around the critical 'distributor-pin' and it will prove difficult to establish a uniform thermal balance over these portions of the die. Moreover, this water-cooling system is ineffective for withdrawing heat from the most vital portion of the 'distributor-pin', ie, its forward rounded tip.

Water may also become trapped in the short portions of the main channels *C* which lie between plugs *D* and the vertical interconnecting inlet and outlet holes respectively. Should this condition arise pockets of almost



LESS WATER FLOW

4. The movable die-block *A* is bored with a two-diameter hole into which is press-fitted the shouldered cylindrical 'distributor-pin' *B*. The smallest size shank of the pin is threaded to take the lock-nut *C* which draws the pin tightly against the step in the hole and retains it firmly in place.

The pin is concentrically hollowed out with the plain drilled hole to form the water chamber *D*. The bottom end of such chamber is machined conical to approximately the same side angle as that of the external taper on the pin, so as to maintain a uniform wall thickness around all portions of the chamber. A headed metal plug *E* is screwed tightly into the tapped end of the chamber, the plug being fitted to insure a close water seal at the joint.

An inlet metallic tube *F* is affixed within the plug *E*; and extends within the internal chamber *D* for almost the full length of same. This inner portion of the tube is slightly bent so that its exit end lies on the center of the chamber.

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super-heated steam will develop at these points, the temperature of which will be grossly excessive for satisfactory working of the die. Permanent hot-spots will thus be created on the surface of the movable die-block.

If hard water has to be employed to feed a water-cooling system of this character troubles may be experienced due to the rapid blocking-up of the several water channels by lime deposits. The die would frequently have to be shut-down and partially dismantled so that the holes could be re-drilled to remove the hard lime accretions.

A much more efficient method of water-cooling a sprue 'distributor-pin' is illustrated at Figure 3. It will, however, be appreciated that a sharply defined circulatory flow does not occur because of the following reasons.

Member *G* is a slightly conical plug fitted tightly into a tapered hole machined centrally up the rounded end of the 'distributor-pin'. The plug is made a permanent fit and its outer end is finished flush with the rounded tip of pin *B*. It also projects an ample distance into the internal chamber *D* having its innermost tip in exact axial alignment with the exit end of tube *E*. The latter member is set so that only a very short gap remains between the plug and its exit end. Plug *G* is made in the same grade of alloy-steel as that of pin *B* so that their expansion rates are precisely the same.

A short outlet tube *H* is also mounted fixedly in plug *E*, but it interjects only a very short distance into chamber *D*. The flow of cooling water through the chamber follows a more truly circulatory path—as indicated by the arrows—than is possible in the case of the preceding example illustrated at Fig. 3.

The incoming stream of cold water passing along inlet *F* is, of course, directed straight to the hottest internal surfaces of chamber *D* and in particular to plug *G* at the rounded tip of pin *B*. Thus heat diffusion from such critical region is far more efficient than in the previous examples.

Temperature variations at this end of the pin *B* are far less pronounced and much more easily regulated with this design of 'distributor-pin', because of the heavier mass of wall metal provided at the pin tip. The intervention of plug *G* therein also ensures a readier and smoother transfer of heat from the hot exterior of pin *B* to the more extensive internal surfaces of the water chamber *D*.

The stream of cold water entering the chamber *C* has to traverse its full length before reaching the smallest end of the chamber, which is of most critical importance from a cooling angle. By the time a supply of water has reached this point near the tip of the pin its temperature will be substantially that of the main body of the pin and to that extent its cooling capacity will be diminished. Thus temperature fluctuations are bound to arise at the extreme rounded tip of the pin.

Furthermore, if the die has to be fitted with a relatively small size 'distributor-pin' which in turn necessitates using a particularly small diameter internal chamber, a steam pocket may quickly accumulate in the restricted chamber at the rounded end of the pin. This will considerably reduce the heat distribution action of the cooling system.

For these reasons, this method of cooling is best applicable for dies having large diameter 'distributor-pins'; or where a heavily massed wall section can be provided around the water chamber.

Continued next page

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It may also be employed satisfactorily in cases where no strict and close control has to be maintained over heat distribution and/or temperature variations with such a pin element.

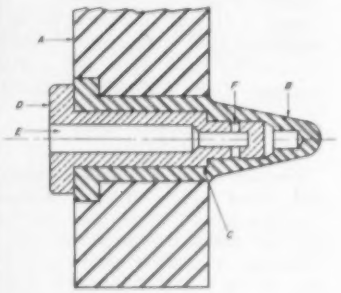
It is worth noting, however, that the cooling action at the tip of the pin will be continued throughout the whole working cycle and not solely during the injection stroke. Thus the temperature of the external conical surface of the pin may drop to an undesirable low level if a long interval has to be allowed for ejecting the casting from the die.

The diagram at Figure 4 depicts the interesting features of an improved design of water cooling system which is free from the foregoing limitations. This gives excellent working results when used with pins of relatively small size; or having thin wall section; or where close control has to be exercised over the temperature at the working tip of the pin.

In the actual application of this design of water cooling system a much smaller volume of water flow is required, because the increase in temperature at the tip of the 'distributor-pin' occurring at each injection shot is much less marked. Since a much reduced water flow is permissible the risks of over-chilling the tip of pin when the die is open, are similarly minimized.

The illustration at Figure 5 shows an effective method of cooling a sprue 'distributor-pin' which does not employ flowing water as the cooling medium.

This type of cooling system is particularly well adapted for use with small size 'distributor-pins' and sprue channels, where the former are of such a small diameter as to forbid forming a sufficiently large size cooling chamber inside the pin.



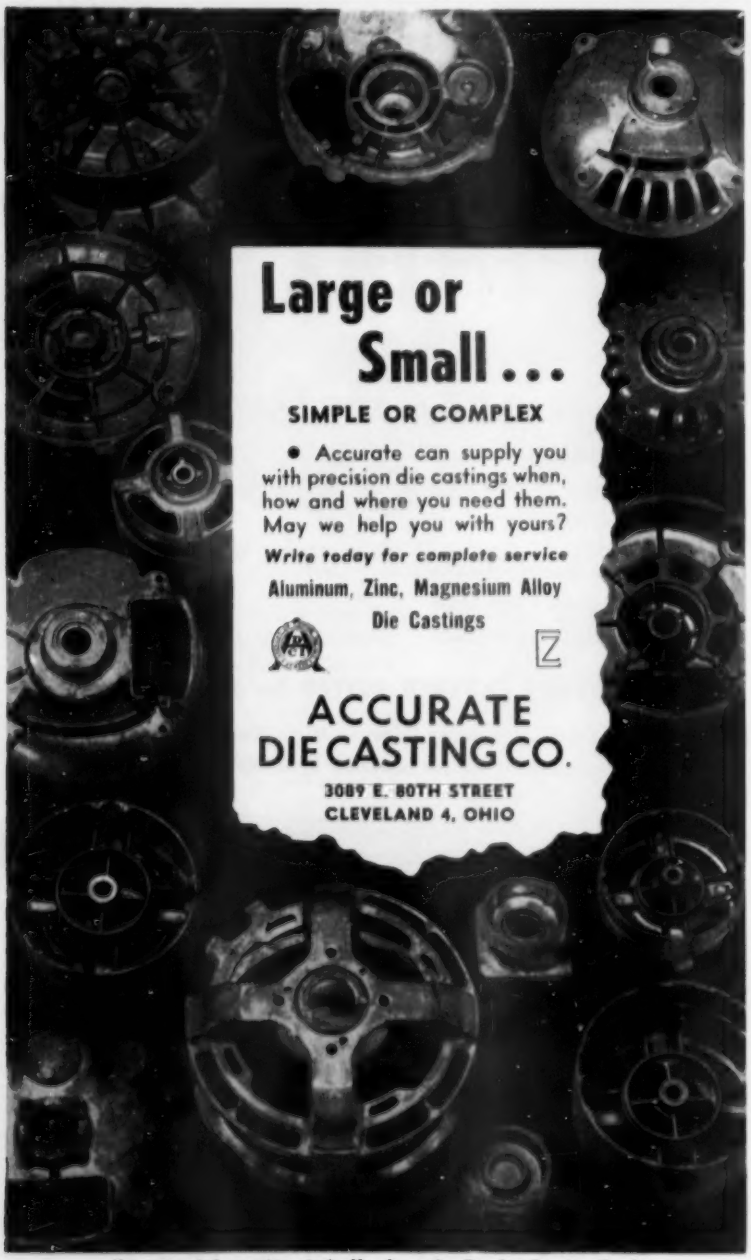
AIR-COOLED

5. The design consists of the following simple elements. *A* is the movable die-block, and *B* is the headed type 'distributor-pin' affixed therein with its conical end projecting in the normal manner beyond the parting-joint surface. The pin *B* is concentrically bored out three different diameters.

Closely fitting in the two largest diameter portions of this chamber is the headed sleeve *D*, which is substantially bored out two diameters for the blind hole *E*. This extends almost to the inner end of the sleeve as shown. The sleeve member is made in beryllium-copper, which material has an extremely high thermal conductivity capacity. The smallest diameter end of the sleeve which fits within the middle size bore of the pin *B* near the conical tip, is drilled diametrically through for the hole *F*.

In use, excess heat accumulating on the external conical surfaces of pin *B* situated within the die sprue channel, is rapidly transmitted to the beryllium-copper sleeve inside the pin. In addition, a natural free flow of air will pass along the large center hole *E* to assist still further in quickly dissipating the heat drawn from the walls of the pin *B*.

If desired the latter action may be usefully accelerated by installing a forced air-flow through hole *E*. This is easily obtained merely by connecting an air-line to the outlet end of hole *E*.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INDEX OF ADVERTISERS: OCTOBER, 1956

A

A.B.C. Die Casting Machine Co. 99
Abbott Ball Co., The 85
ACF Industries 18
Accurate Die Casting Co. 112
Acheson Colloids Co. 47
Advance Tool & Die Casting Co. 107
Allied Research Products, Inc. 74
Alloy Metal Powders, Inc. 97
Almco Div., Queen Stove Works, Inc. 86
Aluminum Smelting & Refining Co., Inc. ..... Cover II
American Die Casting Machinery Co. 87
American Metal Co., Ltd. 10
American Radiator & Standard Sanitary Corp., Ross Heat Exchanger Div. 28
American Zinc Sales Co. 93
Apex Smelting Co. ..... Cover IV
M. Argueso & Co., Inc. 62
Arnhold Ceramics, Inc. 94

B

B & T Machinery Co. 80
Badger Die Casting Corp. 48
Buckeye Brass & Mfg. Co., B-Mold Div. 98

C

Cannon-Muskegon Corp. 22
Carbide & Carbon Chemicals Co., Div. Union Carbide & Carbon Co. 35
Cast-Master, Inc. 1
Celanese Corp. of America 6
Centrifugal Casting Supply Co. 107
Centr-O-Cast & Engineering Co. 18
Certified Alloys Co. ..... Cover II
Chemical Corp. 85
Chrysler Corp., Amplex Div. 63
Cleveland Automatic Machine Co. 17
Conforming Matrix Corp. 85
Crucible Manufacturers' Association 96
Crucible Steel Co. of America 2, 15

D

Dean Precision Castings, Inc. 102
Detroit Electric Furnace Div., Kuhlman Electric Co. 97
Detroit Mold Engineering Co. 111
Dixon Sintaloy, Inc. 84
Dodge Steel Co. 9
Dollin Corp. 14

E

Engineered Precision Casting Co. 27
Esbec Barrel Finishing Corp. 69

F

Fiske Bros. Refining Co. 69

G

Gries Reproducer Corp. 25
Grinding & Polishing Machinery Corp. 69

H

Hammond Machinery Builders, Inc. 90-91
Hanson-Van Winkle-Munning Co. 83
Harbison-Walker Refractories Co. 113
Henning Bros. & Smith, Inc. 4
Hitchiner Mfg. Co. 30-31
Hoover Co., The ..... Cover III
E. F. Houghton & Co. 50
Hydraulic Press Mfg. Co. 32

I

Inductotherm Corp. 102
International Minerals & Metals Corp. 114

J

Wm. F. Jobbins, Inc. 89

K

Kuhlman Electric Co., Detroit Electric Furnace Div. 97
Kux Machine Co. 100

L

Lester-Phoenix, Inc. 7
Lindberg Engineering Co. 95
Litemetal Dicast, Inc. 102

M

Madison-Kipp Corp. 21
Martin Grinding & Machine Works, Inc. 12
Marvel Engineering Co. 109
Merriman Bros., Inc. 108
Mexico Refractories Co. 8
Milwaukee Die Casting Co. 99
Milwaukee Metalube Corp. 34
Minnesota Mining & Mfg. Co. 78
Monarch Aluminum Mfg. Co. 29
Mt. Vernon Die Casting Co. 5

N

National Molded Products, Inc. 104
National-U.S. Radiator Corp., Plastic Metals Div. 103
Neilson Chemical Co. 69
New England Die Casting Co. 38
New Holland Machine Co. 75
New Jersey Zinc Co., The 24
Newark Die Hobbing & Casting Co. 64
Norton Co. 73

Continued next page

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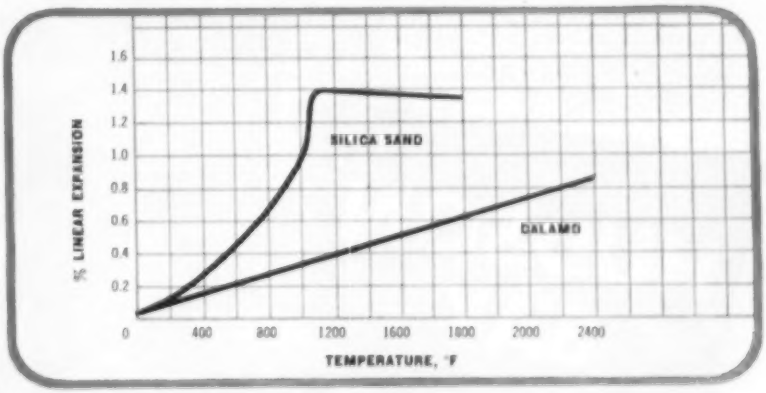

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ADVERTISERS—continued

O

Oakite Products, Inc. 82

P

Paramount Die Casting Co. 106
Parker-Kalon Corp. 79
Parker White-Metal Co. 33
Peerless Aluminum Foundry Co.
Peerless Die Cast & Permold Div. 108
Peters-Dalton, Inc. 66
Precision Piston Rings, Inc. 104
Pyron Corp. 104

R

Rausch Mfg. Co. 87
Reed-Prentice Corp. 26
Reese Metal Products Corp. 98
Republic Steel Corp. 36-37
Roberts Rouge Co., The 72
Roto-Finish, Inc. 76

S

Sel-Rex Precious Metals, Inc. 68
Shell Oil Co. 23
O. W. Smith & Sons, Inc. 20
Speed-D-Burr Corp. 88
Spincraft, Inc. 98
Stroh Die Casting Co., Inc. 114

U

U. S. Reduction Co. 13
United-Carr Fastener Corp. 77
Universal Die Casting Co. 110

W

Westinghouse Electric Corp. 11

For more information circle No. 72 on the Reader Service Card

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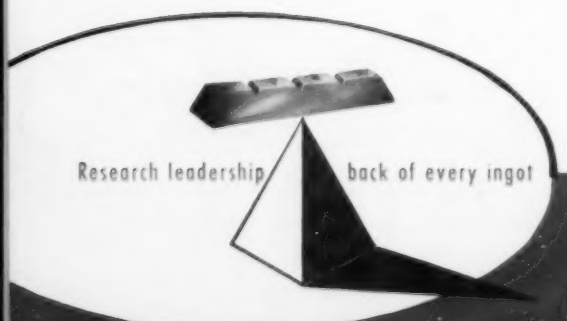

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